SPACE STATION MANAGEMENT

HEARINGS

BEFORE THE

SUBCOMMITTEE ON
SPACE SCIENCE AND APPLICATIONS

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

NINETY-NINTH CONGRESS

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SPACE STATION MANAGEMENT

TUESDAY, AUGUST 5, 1986

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS,
Washington, DC.

The subcommittee met, pursuant to call, at 1 p.m., in room 2318, Rayburn House Office Building, Hon. Bill Nelson (chairman of the subcommittee) presiding.

Mr. NELSON. The Space Subcommittee will come to order. Since we have had so much interest from members who have wanted to look at this issue, I took the responsibility in making out the list of members that will talk, and them in the order of their seniority. Since Congressman Brooks is the dean of the delegation, I have decided to have him in that order as it appropriate according to protocol.

Any the members of the affected delegations, for that matter, any other Member of Congress who would want to speak is welcome to do so. We will do so in the order, basically, of seniority.

Now, I would welcome any other Members of Congress here—I see a couple that are in the audience—you are certainly welcome to come up here and join us at the table, should you so desire. If you would prefer to make your statement from the audience, whatever is your preference. But you are welcome to join us up here.

This subcommittee is beginning hearings on the proposed management changes to the space station, some of those changes announced on June 30, of this year. These changes are significant and they have long-term implications on NASA as an institution.

Before I discuss what we hope to get out of these hearings, I want to comment on an issue of broader concern to this committee. How will NASA and the Congress achieve a working relationship that is in the best interest of the space program in the nation?

Now, this has not been handled the best, thus far. The announcement on June the 30 was made without the appropriate consultation with this committee and the Congress. So, consequently, on July 14, my ranking Republican member, Mr. Walker, and I wrote a letter to NASA asking them to cease implementation of these proposals until we had the opportunity to examine them.

Then last week, NASA announced it would take 90-day review of the decisions before implementing them. Now, this is a step in the right direction.

But I want to remind NASA that our letter, our directive from this committee, of July 14, still stands.

So, our purpose today is to examine, in as much detail as we can, the implication of these management and work package changes.

I think that we will all agree that what is best for the Nation's Space Program is to put into effect a management system that takes the most advantage of the skills that are in NASA and fosters the best communications possible. That, not only is in the interest of the Nation's Space Program, but it is in the interest of one of the programs of NASA, which is the space station, which is the subject of today.

So today we're going to try to examine the merits of these proposed changes to see if the criteria that I have enunciated have been met.

Now, of course, it's difficult to have this kind of hearing without acknowledging the public controversy that some of these proposals have aroused. Now we're not here to pass judgment on the quality of NASA's field centers. The history of our Space Program is greatly enriched by the major contributions that both the Johnson Space Center and the Marshall Space Flight Center have made over the years. Both of these institutions have developed reputations and skills in different areas that are beyond question. So, our hope here today is to use these skills in the best possible way so that we can be on with the Nation's Space Program.

That leads me to another comment. There have been too many factors, in the opinion of this committee—and I speak for my committee—that have led us to a position of where we seem to be without direction in the Space Program. There are a number of people that are advising here and there that are either too technically unsophisticated to grasp the importance of getting our Space Program well balanced and back on track, or either they're too preoccupied with other issues so as to be giving proper advice.

Now whatever the reasons are, there has been too much indecision, and it's created a very unhealthy environment for this Nation's Space Program, and it's time for some of us to start speaking out all the more vigorously. It's time for us to get on with the job. It's time for us to inject again, 6 months after that terrible national tragedy, what was then a sense of national urgency to proceed with the recovery and get our Space Program back on track.

Now the Space Station Program is in many ways different from any space program ever before. It seems to be the next logical step technically, but it also seems to be the next logical step for NASA as an institution, and thus the decisions that we're going to be making in the coming months are going to influence NASA's institutional roles and the identity of its centers for decades to come.

Today, we have invited key officials who will be responsible for making and carrying out those decisions. We're going to hear from Dr. Fletcher and Gen. Sam Phillips, who is the former Apollo Program manager, whose obvious success is well known to all, and who also performed the critical and crucial study recommending the changes in the Space Station Program.

We're going to hear from Dr. Andy Stofan, the new Associate Administrator for the space station, and he is accompanied by John Aaron, presently acting as the Space Station Program manager at JSC; and, indeed, we're absolutely delighted to have a number of our colleagues.

Again, I state to any of my colleagues, you are welcome to make statements, and I arbitrarily, as the Chair, decided that we were going to operate on the basis of seniority, and so I call on our first witness—I beg your pardon; it is customary, indeed, it is right, to turn to my ranking member, Mr. Lujan, for his statement.

Mr. LUJAN. Thank you very much, Mr. Chairman, and it'll be a very short statement, because I know that we all want to get to hearing our witnesses this morning—or this afternoon.

But I hope this hearing will help us sort out the facts from all the heated rhetoric we've been getting lately. We, certainly, want to understand why NASA management is recommending this change at this time. We need to understand the budgetary implications of this proposed move, and, even more importantly, we have to satisfy ourselves that safety isn't being compromised. The near-term effect of this management decision has been confusion and controversy. It's probably a very good idea for NASA to step back and reevaluate that decision.

On the other hand, I'm bothered by what might look to some as an attempt by Congress to overturn a legitimate management decision for political reasons. The future of the space station is too important to let organizational decisions be determined by how many voters there are in one State versus another. Until now, this debate has generated a lot of heat, so let us hope that this hearing will shed some light on this controversial proposal.

I want to thank you, Mr. Chairman, for holding this hearing, and I look forward to some very interesting testimony.

Mr. NELSON. Thank you, Mr. Lujan, and we'll enter into the record my ranking member of the subcommittee, Mr. Walker's statement.

Mr. NELSON. The dean of the Texas delegation, Mr. Brooks.

STATEMENT OF HON. JACK BROOKS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. BROOKS. Thank you very much, Mr. Chairman, and may I congratulate you on your own grasp of this difficulty, or keen perception, and your dedication to this program, that of you and your subcommittee, and I'm glad to appear before you as you begin to look at recent proposals by NASA to alter the Space Station Program.

I am concerned particularly about proposals affecting the habitat module portion of the program, not only because they would adversely affect the Johnson Space Center located in my congressional district but also because they seem at this point to be contrary to the best interests of this particular program and our Nation's traditional strong role in manned space exploration.

From the very beginning discussion about a Space Station Program under the Nixon administration, the concept was developed for a multipurpose facility, but one whose single most unique aspect would be to provide a permanently manned facility for research and development in space. President Reagan reconfirmed this idea in January 1984 when he directed NASA to develop a permanently manned space station within the decade.

Just as the space station concept has always contained a manned space component as its principal goal, so has NASA always looked to the Johnson Space Center as the primary facility for development of manned space activities.

JSC has a proven record of success in this area, with prime responsibility for manned space activities for the Mercury, for the Gemini, for the Apollo Programs, as well as more recently controlling manned flight and space operations, developing flight software, and selecting and training the crews for the space shuttle.

While developing JSC as its prime center for manned space, NASA has followed a similar plan in designating the Marshall Space Flight Center as its main propulsion facility. For each program where JSC was responsible for manned space activities, Marshall has been the prime NASA center to develop and oversee rocketry systems.

This traditional assignment of specific roles for each center has been a wise policy, one which I have long supported. In the highly technical area of space sciences, it makes sense to concentrate experts on various aspects of the programs at the different centers and coordinate the specific developments in designs to the best advantage of the entire effort. We are all aware that there have been some problems along the way, but for the most part our center-specific system has worked well as a cornerstone of our national space effort.

Now, given this excellent performance of a well-tested system, Mr. Chairman, it's most disturbing to see NASA now proposing changes in the Space Station Program that would seem to dilute the special nature and expertise of two of its centers, JSC and Marshall.

It's my feeling that by shifting the primary manned portion of this program, the design, the development, and construction of the habitat module, from the Johnson Space Center to Marshall, NASA is forcing JSC to relinquish its traditional primary role in manned space activities and requiring Marshall to take on responsibilities for which it is not presently equipped.

In addition, I am concerned that this could be the first step on an expensive and poorly planned road toward increasing confusion and rivalry among all NASA centers. It ignores previous substantial investments at specific centers for specific tasks and may well burden all of the centers with performing multiple duties relatively new and for which neither they nor their surrounding support contractors and businesses are properly prepared.

Figures supplied by NASA indicate that while the agency has roughly $156.9 million invested directly in manned space flight development and operations facilities at the Johnson Space Center, the comparable investment at Marshall is only about $28 million, with another estimated and somewhat fuzzed $29.1 million dedicated to support of manned space flight activities from multiprogram facilities.

To my knowledge, NASA has yet to reveal what additional funding would be needed to enhance Marshall's relatively small current investment in the manned space field in order to assume responsibilities for the habitat module under the new proposals, and no ex-

planation of the future use of the sizable investment already in JSC facilities has been provided.

There is also a great deal of uncertainty about the future status of the enormous private sector facilities that have located around Johnson Space Center as it has developed into the prime NASA manned space center.

At a time when our national space policy is shifting toward a stronger role by the private sector in development and performance of new programs, private contractors are justifiably deeply concerned that these latest proposals will serve to undermine sizable commitments in money and property and manpower that have been made over the last 25 years.

Finally, Mr. Chairman, in addition to the concerns that I have expressed regarding an apparent change in the traditional roles played by the centers within the overall NASA framework and the possible waste of millions of taxpayer dollars in past investments, and this at a time when the national deficit is going to be about—the deficit for this year will be about $225 billion, when next year the best econometric people in the country, in the Nation, estimated at a hearing before my subcommittee about 10 days ago that the deficit for next year, for 1987, would be in the range of $200 billion, despite Gramm-Rudman, it makes you wonder why we would waste millions of dollars of investments at the Johnson Space Center and try and start another section somewhere else. They might have just as well picked some other part of the country.

But these latest proposals regarding the habitat module are particularly disturbing as they relate to two specific recommendations put forth in the Rogers Commission report on the space shuttle, *Challenger,* accident.

First, the Commission criticized NASA for departing from the practice employed during the 1960's and 1970's to involve astronauts, astronauts like yourself, Mr. Chairman, in management positions and decisions, where their flight experience and appreciation of operations and flight safety had proved invaluable. The question remains as to how NASA can meet this goal while moving major portions of manned space activities for the space station to Alabama, leaving the astronauts at JSC.

The other recommendation by the Commission relating to this situation concerns the Marshall Space Flight Center and management problems. Of all the centers involved in the space shuttle project, Marshall was singled out as having a tendency toward management isolation and a failure to provide full and timely information bearing on the safety of the *Challenger* flight to other elements of the shuttle program management. The commission specifically directed NASA to take energetic steps to eliminate these tendencies.

It's my belief that at this point NASA would be making a grievous error by placing additional burdens on the management system at Marshall, especially when the expertise already exists at the Johnson Space Center.

In conclusion, Mr. Chairman, I feel strongly that these proposals are mistaken. For 25 years, Johnson Space Center has performed its role as the lead center for manned space activities in a superlative manner. The Marshall Space Flight Center has done a general-

ly good job in propulsion. To make the types of changes which NASA seems to be proposing and did propose in work packages for both Johnson Space Center and Marshall would appear to be a potentially costly venture without justification in terms of improved performance and efficiency.

In short, Mr. Chairman, I've always held the view that if something isn't broken, there's no need to fix it, and until NASA explains adequately the need for this fix-it operation, I cannot and will not support it, and I thank the committee very much for their indulgence and for setting up this hearing and for your continued interest and dedication in a good space program properly managed.

Thank you.

[The prepared statement of Mr. Brooks follows:]

STATEMENT OF CONGRESSMAN JACK BROOKS
HOUSE SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS
AUGUST 5, 1986

MR. CHAIRMAN, I WOULD LIKE TO THANK YOU FOR THE OPPORTUNITY TO APPEAR TODAY BEFORE THE SUBCOMMITTEE AS YOU BEGIN TO LOOK AT RECENT PROPOSALS BY NASA TO ALTER THE SPACE STATION PROGRAM. I AM CONCERNED PARTICULARLY ABOUT PROPOSALS AFFECTING THE HABITAT MODULE PORTION OF THE PROGRAM, NOT ONLY BECAUSE THEY WOULD ADVERSELY AFFECT THE JOHNSON SPACE CENTER LOCATED IN MY CONGRESSIONAL DISTRICT, BUT ALSO BECAUSE THEY SEEM AT THIS POINT TO BE CONTRARY TO THE BEST INTERESTS OF THIS PARTICULAR PROGRAM AND OUR NATION'S TRADITIONAL STRONG ROLE IN MANNED SPACE EXPLORATION.

FROM THE VERY BEGINNING DISCUSSION ABOUT A SPACE STATION PROGRAM UNDER THE NIXON ADMINISTRATION, A CONCEPT WAS DEVELOPED FOR A MULTIPURPOSE FACILITY, BUT ONE WHOSE SINGLE MOST UNIQUE ASPECT WOULD BE TO PROVIDE A PERMANENTLY MANNED FACILITY FOR RESEARCH AND DEVELOPMENT IN SPACE. PRESIDENT REAGAN RECONFIRMED THIS IDEA IN JANUARY 1984, WHEN HE DIRECTED NASA TO DEVELOP A PERMANENTLY MANNED SPACE STATION WITHIN THE DECADE.

JUST AS THE SPACE STATION CONCEPT HAS ALWAYS CONTAINED A MANNED SPACE COMPONENT AS ITS PRINCIPAL GOAL, SO HAS NASA ALWAYS LOOKED TO THE JOHNSON SPACE CENTER AS THE PRIMARY FACILITY FOR DEVELOPMENT OF MANNED SPACE ACTIVITIES. JSC HAS A PROVEN RECORD OF SUCCESS IN THIS AREA, WITH PRIME RESPONSIBILITY FOR MANNED SPACE ACTIVITIES FOR THE MERCURY, GEMINI AND APOLLO PROGRAMS, AS WELL AS MORE RECENTLY CONTROLLING MANNED FLIGHT AND SPACE OPERATIONS, DEVELOPING FLIGHT SOFTWARE AND SELECTING AND TRAINING THE CREWS FOR THE SPACE SHUTTLE.

WHILE DEVELOPING JSC AS ITS PRIME CENTER FOR MANNED SPACE, NASA HAS FOLLOWED A SIMILAR PLAN IN DESIGNATING THE MARSHALL SPACE

FLIGHT CENTER AS ITS MAIN PROPULSION FACILITY. FOR EACH PROGRAM WHERE JSC WAS RESPONSIBLE FOR MANNED SPACE ACTIVITIES, MARSHALL HAS BEEN THE PRIME NASA CENTER TO DEVELOP AND OVERSEE ROCKETRY SYSTEMS.

THIS TRADITIONAL ASSIGNMENT OF SPECIFIC ROLES FOR EACH CENTER HAS BEEN A WISE POLICY, AND ONE WHICH I HAVE LONG SUPPORTED. IN THE HIGHLY TECHNICAL AREA OF SPACE SCIENCES, IT MAKES SENSE TO CONCENTRATE EXPERTS ON VARIOUS ASPECTS OF THE PROGRAMS AT THE DIFFERENT CENTERS AND THEN COORDINATE SPECIFIC DEVELOPMENTS AND DESIGNS TO THE BEST ADVANTAGE OF THE ENTIRE EFFORT. WE ARE ALL AWARE THAT THERE HAVE BEEN SOME PROBLEMS ALONG THE WAY, BUT FOR THE MOST PART, THE CENTER-SPECIFIC SYSTEM HAS WORKED WELL AS THE CORNERSTONE OF OUR NATIONAL SPACE EFFORT.

GIVEN THIS EXCELLENT PERFORMANCE RECORD OF A WELL-TESTED SYSTEM, MR. CHAIRMAN, IT IS MOST DISTURBING TO SEE NASA NOW PROPOSING CHANGES IN THE SPACE STATION PROGRAM THAT WOULD SEEM TO DILUTE THE SPECIAL NATURE AND EXPERTISE OF TWO OF ITS CENTERS, JSC AND MARSHALL. IT IS MY FEELING THAT BY SHIFTING THE PRIMARY MANNED PORTION OF THIS PROGRAM--THE DESIGN, DEVELOPMENT AND CONSTRUCTION OF THE HABITAT MODULE--FROM THE JOHNSON SPACE CENTER TO MARSHALL, NASA IS FORCING JSC TO RELINQUISH ITS TRADITIONAL, PRIMARY ROLE IN MANNED SPACE ACTIVITIES AND REQUIRING MARSHALL TO TAKE ON RESPONSIBILITIES FOR WHICH IT IS NOT PRESENTLY EQUIPPED.

IN ADDITION, I AM CONCERNED THAT THIS COULD BE THE FIRST STEP ON AN EXPENSIVE AND POORLY-PLANNED ROAD TOWARD INCREASING CONFUSION AND RIVALRY AMONG ALL NASA CENTERS. IT IGNORES PREVIOUS SUBSTANTIAL INVESTMENTS AT SPECIFIC CENTERS FOR SPECIFIC TASKS AND MAY WELL BURDEN ALL CENTERS IN THE FUTURE WITH PERFORMING MULTIPLE DUTIES THAT ARE RELATIVELY NEW AND FOR WHICH NEITHER THEY NOR THEIR SURROUNDING

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SUPPORT CONTRACTORS AND BUSINESSES ARE PROPERLY PREPARED.

FIGURES SUPPLIED BY NASA INDICATE THAT WHILE THE AGENCY HAS ROUGHLY $156.9 MILLION INVESTED DIRECTLY IN MANNED SPACE FLIGHT DEVELOPMENT AND OPERATIONS FACILITIES AT JSC, THE COMPARABLE INVESTMENT AT MARSHALL IS ONLY ABOUT $28 MILLION, WITH ANOTHER ESTIMATED $29.1 MILLION DEDICATED TO SUPPORT OF MANNED SPACE FLIGHT ACTIVITIES FROM MULTI-PROGRAM FACILITIES.

TO MY KNOWLEDGE, NASA HAS YET TO REVEAL WHAT ADDITIONAL FUNDING WOULD BE NEEDED TO ENHANCE MARSHALL'S RELATIVELY SMALL CURRENT INVESTMENT IN THE MANNED SPACE FIELD IN ORDER TO ASSUME RESPONSIBILITIES FOR THE HABITAT MODULE UNDER THE NEW PROPOSALS, AND NO EXPLANATION OF THE FUTURE USE OF THE SIZEABLE INVESTMENT ALREADY IN JSC FACILITIES HAS BEEN PROVIDED. THERE IS ALSO A GREAT DEAL OF UNCERTAINTY ABOUT THE FUTURE STATUS OF THE ENORMOUS PRIVATE SECTOR FACILITIES THAT HAVE LOCATED AROUND JSC AS IT HAS DEVELOPED INTO THE PRIME NASA MANNED SPACE CENTER. AT A TIME WHEN OUR NATIONAL SPACE POLICY IS SHIFTING TOWARD A STRONGER ROLE BY THE PRIVATE SECTOR IN DEVELOPMENT AND PERFORMANCE IN NEW PROGRAMS, PRIVATE CONTRACTORS ARE JUSTIFIABLY CONCERNED THAT THESE LATEST PROPOSALS WILL SERVE TO UNDERMINE SIZEABLE COMMITMENTS IN MONEY, PROPERTY AND MANPOWER THAT HAVE BEEN MADE OVER THE LAST 25 YEARS.

FINALLY, MR. CHAIRMAN, IN ADDITION TO THE CONCERNS I HAVE EXPRESSED REGARDING AN APPARENT CHANGE IN THE TRADITIONAL ROLES PLAYED BY THE CENTERS WITHIN THE OVERALL NASA FRAMEWORK AND THE POSSIBLE WASTE OF MILLIONS OF TAXPAYER DOLLARS IN PAST INVESTMENTS, THESE LATEST PROPOSALS REGARDING THE HABITAT MODULE ARE PARTICULARLY DISTURBING AS THEY RELATE TO TWO SPECIFIC RECOMMENDATIONS PUT FORTH IN THE ROGERS' COMMISSION REPORT ON THE SPACE SHUTTLE CHALLENGER ACCIDENT.

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First, the Commission criticized NASA for departing from the practice employed during the 1960's and 1970's to involve astronauts in management positions and decisions, where their flight experience and appreciation of operations and flight safety had proved invaluable. The question remains as to how NASA can meet this goal while moving major portions of manned space activities for the space station to Alabama and leaving the astronauts at JSC.

The other recommendation by the Commission relating to this situation concerns the Marshall Space Flight Center and management problems. Of all centers involved in the space shuttle project, Marshall was singled out as having a tendency toward management isolation and a failure to provide full and timely information bearing on the safety of the Challenger flight to other elements of the shuttle program management. The Commission specifically directed NASA to take energetic steps to eliminate these tendencies. It is my belief that at this point NASA would be making a grievous error by placing additional burdens on the management system at Marshall, especially when the expertise already exists at JSC.

In conclusion, Mr. Chairman, I feel strongly that these proposals are mistaken. For 25 years, JSC has performed its role as the lead center for manned space activities in a superlative manner. The Marshall Space Flight Center has done a generally good job in propulsion. To make the types of changes which NASA seems to be proposing in work packages for both JSC and Marshall would appear to be a potentially costly venture without justification in terms of improved performance and efficiency. In short, Mr. Chairman, I have always held the view that if something isn't broken, then there's no need to fix it, and until NASA explains adequately the need for this fix-it operation, I cannot and will not support it.

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AGAIN, THANK YOU FOR ALLOWING ME TO SPEAK BEFORE THE SUBCOMMITTEE TODAY.

Mr. NELSON. Thank you, Mr. Brooks. We appreciate it very much. You're a good friend, and you're a valued adviser to this committee, and we appreciate you being here very much.

May I call on the junior Senator from Texas, Senator Phil Gramm.

We're delighted to have you here.

STATEMENT OF HON. PHIL GRAMM, A U.S. SENATOR FROM THE STATE OF TEXAS

Senator GRAMM. Thank you, Mr. Chairman.

Mr. Chairman, let me begin by saying that I'd like to identify myself with the remarks of the dean of the Texas delegation. I'd like to begin by thanking you for your leadership on this issue. I think it would have been very easy for you in this position to view our interest in Texas as parochial, to have failed to bring this to a hearing, to have failed to have been involved, and I want you to know that we greatly appreciate your interest and your open mind on this issue.

Mr. Chairman, obviously we are here representing the State of Texas because we're concerned about the Johnson Space Center. We believe the people at the Johnson Space Center have played a critical leadership role in making the United States No. 1 in space, and we believe that they can make America No. 1 in the future as well.

Our interest primarily, obviously, from our own individual interests and the interests of our State, is seeing that the decisions are made in such a way as to give the Johnson Space Center an opportunity to make its case, to put its record before NASA, to give an opportunity for it, through its representatives in the House and Senate, to argue its case before the committees, and clearly we appreciate having an opportunity to do that.

But our interest goes beyond that, Mr. Chairman. First of all, I think it is clear to everyone that the decision that was made by NASA to implement reorganization was not well thought out, was not properly coordinated, and did not follow established procedure. The relevant committees of Congress were not notified, the normal process of input did not occur, and I believe that the decision was flawed.

I want to thank you for your leadership in moving to put that decision on hold. I want to thank the members of the Texas delegation in the House who moved through the appropriation process to achieve the same goal, and I want to thank Dr. Fletcher for deciding to suspend the decision and to set up a 90-day study period so that everybody will have an opportunity now to go back and review the decision so that the centers will have an opportunity to rebid and so that everyone will feel that they get their fair opportunity.

I think there are several relevant questions that need to be looked at here. First of all, I'd like to make it clear, Mr. Chairman, that I believe part of the problem is that Dr. Fletcher, coming into a very difficult circumstance in the most difficult period in the history of NASA, had and has as his primary goal getting the shuttle flying again, and that's what his primary goal ought to be. But I think the preoccupation with that goal has meant that we have not

had adequate review of the decision that was made concerning reorganization. We have an opportunity to do that now, to clear the air and to give everybody a sense that they've participated in the process.

We feel we have a lot to offer at Johnson, not just based on our proven history of leadership but on the fact that we are in a recession in Houston. In looking at our situation, we're not asking NASA to take into account our economic problems, but we are asking them to take them into account indirectly in terms of the availability of quality personnel who would like to work for NASA or its contractors in the Houston area, to take them into account in terms of the availability of office space and manufacturing space for contractors who will be selling services and goods to the taxpayer, and I think when they are taken into account in this final decision, that the availability of skilled labor, the availability office and manufacturing space, will mean that spending money in the Houston area, given the relative depression of that area economically, will mean a higher return for the taxpayer.

I do believe in looking at our budgetary problems and deciding to move people and transfer functions that we've got to look at the cost that that entails, costs not just in terms of disrupting people in their career but disrupting an ongoing process where continuity is critical, costs in terms of the investment in overhead and capital and equipment already made by our contractors in Houston, costs that if they are undertaken somewhere else we don't have to speculate as to who is going to pay that cost, Mr. Chairman, the American taxpayer is going to pay it.

So I feel that for the first time in a long time that we're moving down the right track, that we have suspended the decision, we have set up a process to review it; we have the authorizing and appropriating committees involved; I have worked at great length now with Chairman Garn, who shares with you a distinction of not only being a leader in Congress but being a participant in the Space Program, and I think both of you bring to this debate the kind of credibility that no one else has in terms of an interest for the overall program of NASA.

I am working with Chairman Gorton, and I feel that we in the Senate will do our job of having an input into the process. I'm confident through this action that you will as well, and so I want to thank you for your leadership. I hope that we can have a review, that we can have a rebidding, that we can give all of the centers an opportunity to demonstrate what they can do, that we'll look at all the economic factors, and that we'll make a decision based on what is best for those who have been leaders in the area, on what is best for the taxpayer, and I am confident that everybody having had their day in court, everybody having had an opportunity in that process, that we'll all be satisfied with the outcome.

Mr. NELSON. Thank you, Senator.

Dr. Fletcher certainly has his plate full. Not only does he have the leadership given to him to try to put together what is a nation that is seeking unity in its space program, but in the meantime he has to worry with prescribed payments by the Air Force that are supported by Defense Secretary Caspar Weinberger and Air Force Secretary Pete Aldrich, and expected in excess of $500 million in

fiscal year 1987, suddenly being slashed from the House Armed Services Committee and likewise in the Senate Armed Services Committee. That's one thing that's on his plate.

Second on his plate, he has this enormously challenging new technological marvel of an advanced space station that he wants to have operational by 1994.

Third, in the process as the new leader of an organization that is going through some management changes of trying to boost up the morale and put into place the people that he wants to help him execute on the decisions that's making; and on top of all that, he has to look and worry about the normal funding that occurs day in and day out.

He has to worry about how to have the assured access to space and what should be the blend of ELV's, both military and civilian, and how he can go about building a new expendable launch vehicle industry to allow private enterprise to launch commercial satellites and still keep viable the shuttle, and then when you get to the shuttle, Dr. Fletcher has to worry about how many do we need in that fleet to keep us in the position where we can have manned access to space for the rest of this decade, which he realizes that three won't do it, particularly if you have down time because of repairs or an accident on one until the next generation of manned space vehicle is available.

So he's got a lot on his plate. So I'm hoping that through the course of this hearing we can start getting, as the Book of Isaiah says, "Come and let us reason together," and get people coming together, getting some sense of direction out of this so that it will not be just a parochial fight and so that Dr. Fletcher can attend to the already overflowing plate full of responsibilities that he indeed does have.

We thank you, Senator, for your comments; we appreciate them.

Senator GRAMM. Thank you, Mr. Chairman.

Let me say that I support the statement you made. I'm eager for us to get on with the job of reasserting ourselves in space. I think by reevaluating this decision, by giving everybody an input, we can move forward together, we can all be supportive, and I'm sure we'll all be proud of what we achieve, and thank you.

Mr. NELSON. Thank you, Senator.

Mr. GORDON. Mr. Chairman, may I ask Senator Gramm before he leaves one quick question? I'm afraid he'll be leaving.

Mr. NELSON. All right.

Do you intend to stay, or are you going to leave?

Senator GRAMM. No; I've got to go back. I've got a meeting at 1 o'clock.

Mr. NELSON. All right. If the gentleman is really moved in the spirit, I will defer.

Mr. GORDON. OK.

Mr. NELSON. But it may well open up Pandora's box here, and we've got a list that's going to string us way on into the afternoon.

Mr. GORDON. Just one quick question concerning the proposition of moving the manned system, the outfitting and propulsion systems, the switch between Marshall and Johnson. There seem to be two major questions there; one, the policy; and the other is the best use of our economic resources.

You've taken a high profile nationally on what I think is a very important issue, and that's reducing the national deficit, and I'd just like to ask you the one question. Specifically, do you think that it is the best use of our resources not to switch these functions between the two centers?

Senator GRAMM. Let me first say, Mr. Gordon, that I'm not an expert in the space programs, and I'm not seeking to dictate to NASA, but on the basis of everything I know, on the basis of every piece of information I've seen, and looking at the fixed costs we have in both centers, not just in terms of the physical investment we've made there and contractors have made but the human talent that we've developed there, it seems to me to be a bad idea to make that shift.

Certainly the burden of proof ought to be on the people who want to make the change, because in doing so they're imposing a very heavy cost both on the physical capital we've built and the human capital that's been developed.

Mr. GORDON. So with the information that you have, you have no qualms in stating that the best use of our national resources, the American taxpayers' dollars, would be not shifting the functions?

Senator GRAMM. Well, I can say, based on the information I have, based on the dollars and cents, the investment we've made in people and investment we've made in plant and equipment, that I think the movement of beginning at this late stage, with the proven abilities in propulsion in Huntsville, in the entire involvement of man and his environment in space in Houston, to begin shifting functions, at least on its face, from the point of view of economics, does not seem to make a lot of sense to me, and I think, again, that the burden of proof ought to be on those who are making those proposals, and that's why I think it is so important we're going to set the old decision aside and take a look at the whole decision, get full input from the committees of jurisdiction, draw on their expertise, make a decision; everybody will have been a part of the decision then, and I think as a result everybody can be more supportive of it in the future.

Mr. GORDON. Thank you, Senator.

Senator GRAMM. Thank you, Mr. Chairman.

Mr. NELSON. Mr. Barton, you have one quick question.

Mr. BARTON. A very quick question. I know the Senator has missed more than one 1 o'clock meeting, so we'll keep him another 2 minutes.

Senator, in all of the study that you've done in the last 2 weeks—3 weeks, since this controversy has erupted, have you come across any information, publicly or in your private conversations, that indicates there has in fact been some performance problems at the Johnson Spacecraft Center?

Senator GRAMM. I don't think anybody has ever suggested that that's the case. Again, as I look at it, given the state of the economy, given our budgetary constraints, to me, this is a dollar and cents efficiency argument. I think if we look at it in those terms, what we can buy, where we've made investment, where the talent is, I think those ought to be the factors directing the decision.

Mr. BARTON. Thank you.

Mr. NELSON. Thank you, Senator.

Next in order of seniority is our colleague, the Honorable Bill Archer.

STATEMENT OF HON. BILL ARCHER, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. ARCHER. Thank you, Mr. Chairman.

I compliment you, Mr. Chairman, on your opening comments. Thank you for holding these hearings, and thank you for giving me an opportunity to testify.

I'm sure the committee is aware of my long-standing, fervent support of the Space Program and of NASA's role in leading that effort. But today I must ask the question, what on earth is going on at NASA?

The recent confusion surrounding the agency's proposed changes in the development and construction for the Space Station Program are . clear example. First we heard reports in the Houston press from the Johnson Space Center Director, Mr. Moore, that 1,900 potential jobs may be lost due to changes in the role to be played by JSC. Then we received reassurances from NASA officials here in Washington that there may be a gain of up to 2,000 jobs and that the center may experience substantial growth.

Even when we met with both JSC and Washington NASA officials in the same room at the same time, we received conflicting stories. So something has obviously been wrong.

I have serious concerns regarding the conflicting announcements that have been made in recent weeks, not the least of which is the potential loss of jobs at JSC and in the private industry that associates with it at a time when our Houston area economy is already on its knees. Houstonians are having a hard time enough trying to understand how the Federal Government can continue to stand idly by as the domestic oil industry is destroyed. Now NASA is telling them that their future in the Space Program is also bleak in addition.

But my reservations go beyond the lost job opportunities in a city whose unemployment rate is approaching 13 percent. I want to know specifically what occurred during the decisionmaking process that led NASA officials to conclude that the JSC should be relieved of its responsibility for the Space Station Program, that somehow it is more efficient to dismantle and rebuild a vital portion of its function 1,000 miles away.

Throughout the history of the Space Program, it's natural that Marshall Space Flight Center and the JSC may have viewed themselves as being in competition to some extent. If anything, the conflicting announcements of recent weeks have only helped to perpetuate that competition within NASA and inject a tone of bitterness in it.

I want to quote just two of the many recent comments that have been made by NASA employees as reported in the press. First—and I quote—"A Marshall manager taunted his colleagues at Johnson after the June 30 announcement, jeering, 'How does it feel?'" Second—and I quote—"An employee at Johnson said of Marshall, 'They blew up our orbiter and killed the crew. Why are they being rewarded?' "

To its credit, NASA has now announced a 90-day delay in its final decision on the allocation of the Space Station work packages. But in the meantime, the proposed plan has clearly diminished morale at JSC and heightened the friction that apparently exists among NASA employees in different parts of the country. It is very demoralizing for the employees at the JSC to hear from their own director that they have slipped to second best and that they are losing responsibility for a substantial part of the Space Station Program. This kind of announcement is not the way to help get NASA back on its feet and heading in the right direction.

It is also demoralizing for the people of the Houston area who are suffering from such severe economic recession. Their years of support for the Manned Space Flight Program are now being rewarded by having the rug pulled out from beneath them in one area of economic diversification in which they have excelled, and for what reason? No one at NASA has been able to explain adequately the answer to that simple question.

The space station, as envisioned, is a complex mixture of structure, manned systems, and automated systems. The primary strengths of the Marshall and Johnson Centers must be utilized, in my opinion, not fiddled with, if we are ever to approach the cost and schedule outlined for the Space Station Program.

While it's not necessary to tell this subcommittee the strength of each individual NASA center, it's important that the record reflect the differences in the roles the two organizations have played in the Space Program up to this point. The Marshall Center, along with its associated contractors, is the recognized world leader—and the people in Houston recognize this—in rocket propulsion technology and systems development.

From the day shortly after World War II until today, they have been in the forefront of liquid and solid rocket progress in the free world. They have also carried out programs in space science and applications with superb results. Additionally, the sheer scale of the giant launch systems of Saturn and shuttle has yield valuable experience to Marshall in the handling of large amounts of cryogenic propellants.

But make no mistake, the great primary strength of Marshall is its work in major rocket propulsion systems. From the Redstone vessel to the Saturn to the shuttle, they pushed at the outer fringes and did it well.

The Johnson Space Center in Houston, however, has an equal track record and a different set of skills and accomplishments. From Mercury to Gemini to Apollo to shuttle, the JSC and its associated contractors have been the world leaders in manned space systems technology and development. This has included the design, development, and testing of manned systems as well as the mission planning and flight operations of those systems. Many dollars and countless hours have been expended at and by JSC in developing, as Senator Gramm said, the people, facilities, and infrastructure to accomplish manned space flight. This effort over the last 25 years has yielded a team unequaled anywhere in the world, a unique national resource and asset.

Mr. Chairman, I simply cannot understand, nor has NASA been able to explain, what possible reason there could be for a change in

these basic roles of Marshall and Johnson. I hope that this hearing will shed light on that essential unanswered question. Perhaps the basic problem here is that from the beginning too many people at NASA headquarters and some of the field centers thought of the space station's development as NASA's future or all things for all centers or spread the work.

Put into proper perspective, I submit that the development and construction of the space station cannot be all these things put together or it will have to cost a great deal more than the advertised $8 billion over the next 8 years or so. In constant dollars, the $8 billion for space station development is only one-third that of the shuttle system, and the shuttle development costs were only one-third that of Apollo development costs.

In this perspective, it's clear that development activities of the space station cannot be the, quote, salvation of NASA for the future. The ultimate use and application of the space station will be a much more significant factor for NASA's future than its initial design, development, and construction.

Simply stated, I believe that NASA's attempt to spread the space station work has overly complicated a rather straightforward design and development program, and, more importantly, proposed work allocation plans have not played to the primary strengths of the two major centers involved in its design and construction. In my opinion, this has got to breed inefficiency.

Can it be done that way? Of course. You can do a lot of things inefficiently, as we in Congress know too well, but at what cost, and what schedule, and why? It appears that NASA is taking a planned scarce resource for the space station and splitting it up in a strange and unjustified manner in the name of efficiency. I would argue that, however, the reality of fragmenting the work is less efficient, a problem which is greatly compounded by the proposal's failure to play to the strengths of the Johnson and Marshall Centers.

The facilities and the expertise of the people in Government and industry associated with Marshall and Johnson have formed an efficient working partnership which fit their history, experience, and primary technical strengths. It has taken years of learning, some failures, and many successes. Let's use that unique strength and experience that each NASA center brings to the partnership for the space station and every other effort that NASA undertakes in the future. I believe to do otherwise would not be in the best interests of the United States, the space station, or the Nation.

Thank you very, very much, Mr. Chairman.

[The prepared statement of Mr. Archer follows:]

Testimony of the Honorable Bill Archer
Subcommittee on Space Science and Applications
-- Committee on Science and Technology
August 5, 1986

I would like to thank the Members of the Subcommittee for the opportunity to participate in these NASA oversight hearings.

At the outset, let me emphasize that I have long been a fervent supporter of our nation's space program and NASA's role in guiding and managing that effort. But today I have to ask the question -- What on Earth is going on at NASA?

The recent confusion surrounding the agency's proposed changes in the development and construction for the space station program are a clear example.

First we heard reports in the Houston press, from Johnson Space Center Director Jesse Moore, that 1,900 potential jobs may be lost due to changes in the role to be played by the Johnson Center. Then we received reassurances from NASA officials here in Washington that there may be a gain of 2,000 jobs and that the center may experience substantial growth. Even when we met with both JCS and Washington NASA officials in the same room at the same time, we received conflicting stories. Something is obviously wrong here.

I have serious concerns regarding the conflicting announcements that have been made in recent weeks -- not the least of which is the potential loss of jobs at Johnson Space Center, and in the private industry associated with it, at a time when our Houston-area economy is already on its knees.

Houstonians are having a hard enough time trying to understand how the federal government can continue to stand by idly as our domestic oil industry is destroyed. Now NASA is telling them that the city's future in the space program is bleak as well. But my reservations go even beyond the lost job opportunities in a city whose unemployment rate is fast approaching 13 per cent.

I want to know specifically what occurred during the decision making process that led NASA officials to conclude that Johnson Space Center should be relieved of responsibility for the Space Station program -- that somehow it is more efficient to dismantle and rebuild a vital portion of its function a thousand miles away.

Throughout the history of the space program, it's natural that Marshall Space Flight Center and the Johnson Space Center may have viewed themselves as being in competition to some extent. If anything, the conflicting announcements of recent weeks have only helped to perpetuate that competition within NASA and inject a tone of bitterness in it.

I want to quote just two of the many recent comments that have been made by NASA employees -- as reported by the Houston Post:

1. "A Marshall manager taunted a colleague from Johnson after the June 30th announcement, jeering, 'How does it feel'."

2. "An employee at Johnson said of Marshall, 'They blew up our orbiter and killed the crew. Why are they being rewarded'."

To its credit, NASA has now announced a 90-day delay in its final decision on the allocation of the space station work packages -- but, in the meantime, the proposed plan has clearly diminished morale at Johnson Space Center and heightened the friction that apparently exists among NASA employees in different parts of the country. It is very demoralizing for the employees at the Johnson Center to hear from their own director that they have slipped to second best and that they are losing responsibility for a substantial part of the Space Station program. This kind of announcement is not the way to help get NASA back on its feet and heading in the right direction.

It is also demoralizing for the people of the Houston area ,who are suffering from a severe economic recession. Their years of support for the manned space flight program are now being rewarded by having the rug pulled out from beneath them in one area of economic diversification in which they have excelled. And for what reason? No one at NASA has been able to explain adequately the answer to that simple question.

The space station, as currently envisioned, is a large and complex mixture of structure, manned systems and unmanned (or automated) systems. The primary strengths of the Marshall and Johnson centers must be utilized -- not fiddled with -- if we are ever to approach the cost and schedule outlined for the space station program.

While it's not necessary to tell this Subcommittee the strength of each individual NASA center, it's important that the record reflect the differences in the roles the two organizations have played in the space program thus far.

The Marshall Space Flight Center in Huntsville, Alabama, along with its associated contractors, is the recognized world leader in rocket propulsion technology and systems development.

From the days shortly after World War II until today, they have been in the forefront of liquid and solid rocket progress in the free world.

They also have carried out programs in space science and applications with superb results. Additionally, the sheer scale of the giant launch systems of Saturn and Shuttle has yielded valuable experience to Marshall in the handling of large amounts of cryogenic propellants.

But make no mistake. The great primary strength of Marshall is its work in major rocket propulsion systems. From the Redstone missile to the Saturn to the Shuttle, they pushed at the fringes of impossibility to roll back the technology barriers in liquid and solid rocket propulsion.

The Johnson Space Center in Houston, Texas has an equal track record in a different set of skills and accomplishments. From Mercury to Gemini to Apollo to Shuttle, JSC and its associated contractors have been the world leaders in manned space systems technology and development. This has included the design, development, and testing of manned systems, as well as the mission planning and flight operations of those systems. Many dollars and countless hours have been expended at and by JSC in developing the people, facilities and other infrastructure to accomplish manned space flight. This effort over the last 25 years has yielded a team unequaled anywhere -- a unique national resource and asset.

Mr. Chairman . . . I simply cannot understand . . . nor has NASA been able to explain . . . what possible reason there could be for a change in these basic roles of Marshall and Johnson. I hope that this hearing will shed some light on that essential unanswered question.

Perhaps the basic problem here is that, from the beginning, too many people at NASA headquarters and some of the field centers thought of the space station development as "NASA's future," or "all things for all centers," or "spread the work." Put into proper perspective, I submit that the development and construction of the space station cannot be all of those things -- or it will have to cost a great deal more than the advertised $8 billion over the next 8 years or so.

In constant dollars, the $8 billion for space station development is only one-third that of the Shuttle program . . . and the Shuttle development costs were only one-third that of Apollo development costs.

In this perspective, it's clear that development activities of the space station cannot be the "salvation" of NASA for the future. The ultimate use and application of the space station will be a much more significant factor for NASA's future than its initial design, development and construction.

Simply stated, I believe that NASA's attempt to spread the space station work has overly complicated a rather straightforward design and development program. And . . . more importantly . . . proposed work allocation plans have not played to the primary strengths of the two major centers involved in its design and construction. That has got to breed inefficiency.

Can it be done that way? Sure . . . You can do a lot of things inefficiently . . . but at what cost and schedule. And why?

It appears that NASA is taking a planned scarce resource for space station and splitting it up in a strange and unusual manner in the name of efficiency. I would argue, however, that the reality of fragmenting the work is less efficient -- a problem which is greatly compounded by the proposal's failure to play to the strengths of the Johnson and Marshall centers.

The facilities and the expertise of the people in government and industry associated with Marshall and Johnson have formed an efficient working partnership which fit their history, experience and primary technical strengths. This has been derived not by administrative edict -- but rather by years of learning . . . some failures . . . and many successes.

Let's use that unique strength and experience that each NASA center brings to the partnership for the space station and every other effort that NASA undertakes. To do otherwise . . . and for no valid reason . . . would not be in the best interest of the United States Space program or the Nation.

Thank you very much. This concludes my prepared remarks.

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Mr. NELSON. Thank you, Mr. Archer.

You know, since we have so many Members of Congress present today, this is a good opportunity for us to have a little prayer session about some of the things that are needed in America's Space Program. You've heard me make some opening comments before.

The fact is that many people are here concerned about, as they should be, the parochial interests with regard to their own personal concerns and congressional districts. But this leaderlessness, this seeming indecision about the Nation's Space Program would be well to be attended by each of you in your own way, and you can help a great deal.

I can tell you, the folks out there in America strongly support America's Space Program and of us getting off the dime and moving out and having a vigorous and robust Space Program, and so a number of the items that I mention that are on Dr. Fletcher's plate, specific items such as the question of the replacement orbiter, such as the question of the Air Force payment, such as the question of the space station design, in addition to the question of Alabama and Texas, would be most appropriate for each of you to make note of and join together in the goal that we all want, which is unity.

Thank you, Mr. Archer. We appreciate it very much.

Mr. ARCHER. Thank you, Mr. Chairman.

Mr. NELSON. The senior Senator from Texas, Senator Bentsen.

STATEMENT OF HON. LLOYD BENTSEN, A U.S. SENATOR FROM THE STATE OF TEXAS

Senator BENTSEN. Thank you very much, Mr. Chairman.

I heard your comment about parochial interests. I plead guilty. I have that. But I think I have more than that. I think I have the interests of what's best for our country and NASA and the Space Program, and I believe in that old adage, "If it ain't broke, don't fix it," and the Johnson Space Center has done an exemplary job in the Space Program and with its responsibility in it, and so has the Marshall Center when you're talking about propulsion.

But now what are they talking about? They're talking about this one, picking it up and moving it over here, and picking up that one and moving it over there, switching the roles of the two of them. I don't think that's in the best interests of the taxpayers of this country, and I don't think it's in the best interests of NASA in trying to do something about the Space Program.

The Johnson Space Center has long had a reputation for excellence in management, and I want to see that continued in a primary role. So, I would hope during this 90-day period, Mr. Chairman, that you and this committee will take a very critical look, as I know you will, an objective look, at what's best for the Space Program, and when we're looking at management practices—and I was a businessman before I came here and had some experience with management practices—when you have a report given to you, you have to look at the entire parameters of it, what you have that goes with it other than just the table of organization.

What you have here in Houston is an infrastructure that's helpful to NASA. You have one of the great medical centers of the

world in the Houston Medical Center. They'll spend over $1½ billion this year just in new facilities. That's what's under way there.

Now you have the interplay that takes place between the scientists who have the responsibility for the habitation part of the module. You're going to lose some of that as they move to Marshall, to Huntsville. Marshall, AL, is a delightful city, a fine community, but it doesn't have that kind of a facility adjacent to it.

You have a whole collection of universities that are available, and you have the interplay with the scientists that are now there at the Johnson Space Center. You have Rice University, you have the University of Houston, you have parts of Texas A&M there and parts of the University of Texas. All of this interplay, I think, is a great assist to the scientists at the Johnson Space Center. They marry many of the research and development projects to space-developed technology that works for the professors, for the universities.

The medical applications of technology developed at JSC include the development of a portable, computerized cardiac system that offers physicians a new approach for monitoring ambulatory patients with heart disease, not particularly applicable to rocket propulsion, but it certainly does fit in when we're talking about the habitation part of that module.

JSC has encouraged and promoted academic relations with all of these universities, and we've had a rich interchange of faculty and scientific inquiry between JSC and the Texas University community.

You have university research arms like Southwest Research Center in San Antonio, whose work in biomedical technology is premier in the Nation; park; the Houston Area Research Center; the university space research are interlinked with JSC in its life science component for the space station.

Finally, I ask that you review JSC's oversight role in the event that the proposed plan is adopted. Under NASA's plan, JSC would lose the habitation component but retain oversight of the project. Similar relationships between Johnson and Marshall have existed during the Apollo and the Skylab Program over the development of life science systems at Marshall but under JSC's control. Now efficiency, cost, and practicability of such an arrangement just has to be reviewed from a management standpoint.

The Johnson Space Center is currently equipped with facilities to further expand and develop their study of life systems engineering. Now if you take those facilities and either move them or duplicate them, that certainly has to cost the taxpayers a lot of money and loss in time in the program. That's a highly specialized technology, and I'm not convinced that NASA's announced change will necessarily produce those dollar savings or shorten the time it will take NASA to get our Space Program back on track.

The Johnson Space Center's initial charter established its mission as a manned space center. Since that time, it's been a source of pride not just for Houston and Texas but I think for the entire country.

I suppose some things have been said about some of the economic problems we're having in Houston, and they are major, and it's not your obligation to award contracts or appropriations based on what

the economic problems are of an area. But I think in this there are some things to be found that benefit NASA, things to be found to benefit those companies, and that industry that wants to come in with the interplay that takes place in the work of NASA, the contractors and the subcontractors.

You have a great availability of housing, great selection of housing on the part of those employees coming in. You have low rents, abundant office space, all of that available for immediate occupancy. That doesn't just help the local community, that helps in the bids that are made to NASA by those contractors, by those businesses that come in. As they calculate their bids, all of that has to be taken into consideration. So, I think it's a major plus to keep the responsibility there and not disrupt a winning team.

Mr. Chairman, I appreciate your time.

Mr. NELSON. Thank you, Senator Bentsen.

Next in order of seniority is the Honorable Ronnie Flippo of Alabama.

Congressman Flippo, you're welcome to be seated there or at the committee table, whichever is your preference.

STATEMENT OF HON. RONNIE G. FLIPPO, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ALABAMA

Mr. FLIPPO. Thank you, Mr. Chairman and members of the committee.

I have great feeling for you as you struggle to deal with this, as I sit there listening, as you did, and heard some extreme statements made today by other witnesses, my colleagues, some inflammatory and others, it's a strain to listen to some of those kind of statements and not respond in kind, but I know that your interest and the interest of this committee is so great that what you're interested in is what's going on.

What we're really talking about here today is the importance of the space station, the whole Space Program. We're talking really about the future of our Nation. We're talking about extending man's presence into space permanently, like the Russians are. We're talking about science and technology and the economic development that comes from that that's so important to our Nation.

I think it's important to note that our Space Program move on. As you said initially, it's not going forward. We need to signal the Soviets that the space station is not their total domain and their only prerogative. We need to signal those in the international community that the United States is a dependable partner and that cooperation is beneficial, and we're not doing that now. We need to show the world, Mr. Chairman, as we deal with adversity, that we continue to look to the future.

What we're really talking about in the space station, we're really talking about leadership in space. No doubt the last 25 years we have been preeminent in space. The question is, where are we going to be the next 25 years? Are we going to be the leaders in space?

One of the major efforts for our space station, it's not going to be something you build and fly and forget, it's a permanent facility there, as I know all of you know, and managing such an effort de-

serves the support of this Congress and this committee. Managing these complex programs is not simple, and certainly as you all know that it's not simple days for NASA.

The program has made some progress even though they are not too evident right now. I think our job and—if you would permit me, Mr. Chairman—I believe your job is to balance our oversight responsibilities with a sense of restraint that enables NASA to do its job. Ours is a policy job, Mr. Chairman, not a management job.

Recently, NASA made some space station management decisions, and I think those decisions should be viewed in the context of the Rogers Commission report, and I mean all of the Rogers Commission report, not just the parts that some would like to select, but the whole context of the Rogers report suggested and recommended that NASA strengthen its management at headquarters in Washington, not necessarily among centers but in Washington, and that was the thrust of one of the decisions which I believe that decision would be reversed by the amendment added by the Appropriations Committee the other day; I think that was unwise. But I think that we have to view it in view of the Rogers Commission report and the General Phillips report.

NASA didn't just go out and suddenly decide to take some action, they had a man who was in charge of the Apollo Program, a man who was in charge of the Minuteman Program, one of the most highly qualified experts in the country today, to go out and do a study and tell them how they could improve that, and they based it on that decision.

So I think that as we deal with this, these two decisions made by NASA deal with overall management structure, and they deal with the distribution of the work station package within NASA.

Now I'm going to leave, of course, to Dr. Fletcher and Dr. Stofan NASA's rationale, but as I understand it, their rationale was to strengthen the headquarters role in management as recommended by the Rogers Commission, and to improve communications, and to assure objectivity in systems engineering. I think the accountability in the work packages was one of the driving forces, and I'll be interested in hearing them explain why accountability is so important.

Mr. Chairman, I think that the decisions that NASA made were sound and they were sensible, and they were certainly within the proper role of a NASA administrator. I do think that NASA could have done a better job of keeping Members of Congress informed, and I think that Dr. Fletcher has agreed to hold off for up to 90 days.

Dr. Fletcher's decision—Mr. Chairman, I think that there has been an erroneous portrayal of this controversy to this committee and to the public. This is not a controversy between Johnson and Marshall, Mr. Chairman. I don't believe there's a single member of this committee or anyone else who can point to a single statement by an official at Marshall Space Flight Center or the chamber of commerce in Huntsville or anyone else in that region.

This is not a controversy between Marshall and Johnson, this is a controversy between the headquarters and Johnson, and it raises the legitimate question of who is in charge. Is Dr. Fletcher in charge, or is Johnson in charge? Is the program going to be run by

a field center, or is it going to be run by headquarters? Is it going to be run by the Houston Chamber of Commerce? Who is it going to be run by? Is it a program for jobs? I don't think so, Mr. Chairman. I think that Dr. Fletcher's decision to hold off is a sign of cooperation. I think he needs to realize, and I believe he does, that many of us in Congress are vitally interested in all aspects of the Space Station Program, and we need to realize that the decisions that he wishes to make are reasonable and they're based on sound principles, and they should not be arbitrarily reversed.

I would just read to you a description of the work breakdown structure at Johnson, at Marshall, at Goddard, and Lewis. One of the descriptions for Marshall says that the Marshall Space Flight Center manages the space station propulsion system, its logistics, and the pressurized laboratory and habitability modules. They already had responsibility in there, and I think some of the more inflammatory statements that have been made here in regard to Marshall's activity, I think we can put Marshall up against any center in the world.

Mr. Chairman and members of the committee, I think you know that we're not talking about a space program for Alabama or a space program for Texas, or Goddard, or Lewis, we're talking about the Nation's Space Program, and I feel comfortable that you will do what's in the Nation's best interests and not be pressured into considering this a matter of parochial interest.

I, too, as the Senator from Texas, have some interest in what goes on at Marshall Space Flight Center, but I have a greater interest, Mr. Chairman, in what goes on in the Nation's program, and I think that one of the major things NASA has to do is to get in control of its programs, and the way to do that is the way they're proceeding, and a reversal of that would be micromanagement and be carrying us in the wrong direction and result in a detriment to the Space Program, and I thank you for the opportunity to testify today.

Mr. NELSON. We're delighted to have you here. Thank you, Congressman Flippo.

Next in order of seniority is our colleague on the committee from Texas, the Honorable Ralph Hall.

STATEMENT OF HON. RALPH M. HALL, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. HALL. Thank you, Mr. Chairman, and I certainly subscribe to the words that have been spoken from other Members as to that that's best for this country. As Jeremy Bentham said, the greatest good for the greatest number.

So much history, Mr. Chairman, emanates from the pursuit of space, from the beep-beep of the first satellite to the leadership of this great committee by Louisiana's Overton Brooks, California's George Miller, Texas' Olin "Tiger" Teague, and the very invaluable and intelligent and logical leadership of Don Fuqua on up to today.

You know, the space thrust has had enough setbacks, and really the jury is still out on whether or not they were caused by negligence or providence, but now we have rumors that are wrecking

the plans and dreams of helpless families in both Alabama and Texas.

I think there has been too much talking without thinking and too much acting without talking, and now the latest decision is to be indecisive for three more months. Others have thought that's a good thrust, but I think the only mistake that would be greater than such indecision would be no decision at all. The decision ought to be made, Mr. Chairman and members of this committee, immediately to support the heart and soul of manned space, a proven area, constructed, by the way, with pre-Gramm-Rudman dollars, where the astronauts live and work, a mother hen type operation with the chicks already in place, where skilled technicians are already settled in.

Just to be brief, I think we need to keep on doing what we've been doing and doing it well where we've been doing it.

I yield back the balance of my time.

Mr. NELSON. I thank you, Mr. Hall. You're a valued member of this committee, and we appreciate your participation.

We're delighted to have our colleague from Texas, the Honorable Jack Fields, that is joining us today.

Mr. Fields.

STATEMENT OF HON. JACK FIELDS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. FIELDS. Mr. Chairman, thank you, first of all, for holding this timely hearing, and thank you for your generosity in allowing those of us who are not members of the subcommittee to come and make opening statements and later ask questions, and for that reason I want to forego an opening statement. I think there have been a number of opening statements already. People have stated very well the problem.

But let me say just in as brief a way as I can, some of us are extremely concerned at the pronouncement that was made on June 30 by Dr. Fletcher. Some of us now believe that there must be great confusion at NASA because, you know, we had that statement on June 30.

As early as Friday a week ago, we were told that the decision was final; this past Thursday, we were told there was a 90-day moratorium; and that confusion is leading to some real people problems at the Johnson Space Center, people who have dedicated their lives to our space effort not only at Johnson but throughout the NASA system, people who have home mortgages, people who have children in school, and I want to join with my good friend, Ralph Hall, in saying that the time for a decision is now, to give some direction, and I think what you said just a moment ago, Mr. Chairman, that now is the time that we need leadership, and I think that you're exhibiting the type of leadership we need in having this hearing today and getting a full airing of this issue, and I certainly appreciate what you're doing and support you in this effort.

Thank you very much.

[The prepared statement of Mr. Fields follows:]

STATEMENT BY
CONGRESSMAN JACK FIELDS (R-TX8TH)

REGARDING
NASA'S ANNOUNCEMENT TO REORGANIZE THE SPACE STATION PROGRAM

BEFORE
THE SCIENCE AND TECHNOLOGY SUBCOMMITTEE ON SPACE
SCIENCE AND APPLICATIONS

MR. CHAIRMAN, I WOULD LIKE TO COMMEND YOU FOR CALLING THIS HEARING TODAY, ON NASA'S JUNE 30TH DECISION TO REORGANIZE THE SPACE STATION PROGRAM.

WITH THE SPACE SHUTTLE TRAGEDY ON JANUARY 28TH, NASA-- AND OUR SPACE PROGRAM-- ENTERED A DIFFICULT PERIOD OF SELF-SEARCHING. NASA IS NOW TRYING TO REGROUP AND REGAIN ITS STATUS AS THE WORLD'S PREMIER SPACE AGENCY WITH THE WORLD'S PREMIER SPACE PROGRAM. I APPLAUD NASA'S EFFORTS, BUT I ALSO BELIEVE THAT ANY SIGNIFICANT RESTRUCTURING SHOULD BE REVIEWED BY CONGRESS.

ON JUNE 30TH, NASA ANNOUNCED A MULTIPART RESTRUCTURING PLAN FOR THE SPACE STATION PROGRAM. THE PLAN INVOLVES NOT ONLY APPOINTMENT OF AN ASSOCIATE ADMINISTRATOR FOR THE SPACE STATION, BUT THE MOVEMENT OF MID-LEVEL NASA MANAGEMENT TO WASHINGTON AND THE SHIFTING OF SPACE STATION WORK BETWEEN VARIOUS CENTERS.

SOME OF THESE DECISIONS MAY BE GOOD, AND THEY MAY BE COST EFFECTIVE. HOWEVER, I AM CONCERNED THAT THE SHIFTING OF WORK BETWEEN SPACE CENTERS MAY NOT BE COST EFFECTIVE.

FOR EXAMPLE, NASA'S REORGANIZATION PLAN WOULD MOVE THE HABITATION MODULE WORK TO THE MARSHALL SPACE CENTER AND THE PROPULSION WORK TO THE JOHNSON SPACE CENTER. IT SEEMS NOT ONLY FISCALLY IRRESPONSIBLE BUT ALSO ILLOGICAL TO MOVE THE RESPONSIBILITY FOR PROPULSION DEVELOPMENT AWAY FROM THE PROPULSION EXPERTS AT THE MARSHALL CENTER AND THE RESPONSIBILITY FOR HABITATION MODULE WORK AWAY FROM THE ACKNOWLEDGED WORLD CLASS EXPERTS AT JOHNSON CENTER.

I AGREE WITH DR. FLETCHER THAT THE SPACE PROGRAM IS NOT A "JOBS" PROGRAM, BUT NASA'S JUNE 30TH ANNOUNCEMENT HIT HOUSTON AT A TIME WHEN UNEMPLOYMENT IS A RECORD LEVEL OF 13%.

PRIOR TO NASA'S JUNE 30TH ANNOUNCEMENT, THE HOUSTON BUSINESS COMMUNITY HAD MADE THE JOHNSON SPACE CENTER'S LEAD ROLE IN SPACE STATION A KEY PART OF ITS ECONOMIC REDEVELOPMENT PLAN. SINCE THE ANNOUNCEMENT, SOME BUSINESSES PLANNING TO RELOCATE TO HOUSTON HAVE PUT PLANS ON HOLD.

THE JUNE 30TH ANNOUNCEMENT AND SUBSEQUENT CONFLICTING NASA REPORTS ABOUT THE EFFECT OF THE SPACE STATION REORGANIZATION ON THE JOHNSON SPACE CENTER LEAD ME TO BELIEVE THE NASA DECISION MAY

HAVE BEEN PREMATURE. I FEEL THAT THE MOST RECENT DECISION MADE BY NASA TO PUT THE SPACE STATION REORGANIZATION PLAN ON HOLD FOR A PERIOD UP TO 90 DAYS UNDERSCORES THE HIGH DEGREE OF CONFUSION AND LACK OF PREPARATION THAT PRECIPITATED NASA'S JUNE 30TH ANNOUNCEMENT.

MR. CHAIRMAN, IT IS TIME FOR CONGRESS TO STEP IN AND CAREFULLY STUDY THIS MATTER. CERTAINLY NASA SHOULD NOT BE ALLOWED TO PROCEED WITHOUT CONGRESSIONAL APPROVAL. AGAIN, I COMMEND THE SCIENCE AND TECHNOLOGY SUBCOMMITTEE ON SPACE SCIENCE FOR HOLDING HEARINGS ON THIS MOST URGENT SITUATION.

THANK YOU, MR. CHAIRMAN.

Mr. NELSON. Thank you, Mr. Fields.

Next in line of seniority is our immediate past member of this committee, who has just gone on to another committee, the Honorable Mike Andrews.

We're delighted to have you, and let me take this occasion. This is the first time that his replacement, also from Texas, the Honorable Jim Chapman, is here, and we welcome you. We're just delighted that you're going to be a member of this subcommittee, and I guess this is your first participation.

Mr. CHAPMAN. It is, Mr. Chairman. I appreciate that and look forward to working with you and the subcommittee, and the full committee, along with the chairman.

Mr. NELSON. Indeed. It's our loss that Mike has gone but our gain that you're here.

Mr. Andrews.

STATEMENT OF HON. MICHAEL A. ANDREWS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. ANDREWS. Thank you, Mr. Chairman.

I first want to thank you for calling this hearing and allowing those of us that are no longer on the committee an opportunity to participate in these most important deliberations.

The Rogers Commission report and our committee's subsequent deliberations on the *Challenger* accident very clearly demonstrated the need for more effective congressional oversight of NASA's activities and clearly called upon NASA to improve its communications. That includes consultation with the Congress.

The proposed reorganization plan for the Space Station Program that was announced on June 30 by Dr. Fletcher dictates a major change in the direction of our Nation's Space Program. This announcement will have far reaching consequences on the Space Program not only in the short term but for generations to come.

The decision was announced by NASA headquarters without consultation with any Member of the U.S. Congress. It was not until a personal meeting between Congressman Nelson and Dr. Fletcher and myself that NASA even agreed to relinquish vital information and statistical data for our committee to attempt to evaluate the significance of this major change in direction.

On July 14, as the chairman has mentioned earlier, Congressman Nelson and Congressman Walker instructed in writing Dr. Fletcher to stop the process, to not implement this plan until Congress had been fully consulted and advised and had an opportunity to approve of this change in policy. Yet when he was in Houston recently, Dr. Fletcher told the employees of the Johnson Space Center that his decision was final and that he would not change his mind.

Then last week, on the very same day and during a markup hearing on the Appropriations Committee in which that committee prohibited any use of any Federal taxpayer dollars for the implementation of this plan, Dr. Fletcher than stated that he would wait 90 days to implement his program.

These actions, I believe, only underscore the poor communications and the real misunderstanding that currently exists between NASA, the employees of the Johnson Space Center, and other cen-

ters around the country, and the Congress. Over the past week, it has become very apparent to all of us that NASA announced this decision without fully considering the many effects that their decision would result in and the numerous questions that would arise.

On technical grounds, there appear to be very serious flaws in an order that moves the responsibility for propulsion development away from the propulsion experts at the Marshall Space Flight Center and the responsibility for manned systems development away from the acknowledged world-class manned space experts at the Johnson Space Center. This is the very heart of this issue and the very heart of the talent, the resources, and the facilities at the Johnson Space Center in Houston.

On the question of assessing the impact of this move, within the last two weeks NASA has confirmed the validity of at least three different sets of statistics analyzing the personnel and economic impact of this order in Houston. They initially confirmed that 1,900 jobs would be lost and that $1.5 billion in prime contract dollars would be removed from the Houston area.

Later, the jobs figures increased until finally we were told within that 2-week period that we would gain 3,000 jobs if this plan was only allowed to go forward. Regrettably, no analysis—none—was made prior to the announcement on June 30.

Additionally, no cost analysis that we are aware of was made to calculate the cost of the move—what will it cost the taxpayer just simply to make this move, to implement the order. Headquarters has responded that they have not done this analysis because the decision was not complete. Well, if that's so, why did they issue the plan at a press conference on June 30?

On economic questions, Dr. Fletcher said in Houston, "NASA is not an organization that gives work out to people under distress." In addition, Dr. Fletcher stated that he has no requirement to consider the local impact of his decision. Such a requirement may not be stated in the Federal regulations, it really shouldn't have to be.

It is unthinkable not really to consider the impact of such a decision on a local community. As we have heard earlier today, of the 11 most populous States, the leader in unemployment is Texas. The severe economic crisis that affected the oil producing States has hit Texas the hardest and Houston the worst. Not to think about the impact of such a major change in policy is not only insensitive, I don't think it's being responsible.

However, beyond the local impact that NASA is not concerned about, what about the development of the commercial potential of space, which is one of our Nation's most important goals? The unique manned systems' expertise and facilities at the Johnson Space Center have attracted individuals and talent and money and companies from around the world to Houston. This major shift in organization will greatly affect the efforts that we've accomplished thus far and the investments that have already been made. What we need to do as a Congress and as an agency is to nurture these resources and this investment already made.

Considering the high degree of confusion and lack of preparation prior to June 30, I'm very pleased that the Space, Science Subcommittee is taking this opportunity to step in and begin to review the situation and sort out these important questions that must truly be

resolved if we're going to get the Space Program back on track. Certainly NASA should not be allowed to proceed without proper consultation with the Congress.

You know, I agree very much with my good friend and colleague, Ronnie Flippo from Alabama, we really can't have a Texas-based program any more than we can have an Alabama program. I'm most convinced from my review of this analysis and the actions that have been taken in the last 2 weeks that the plan that Dr. Fletcher announced on June 30 is not in the best interests of our country's Space Program.

In a meeting with the Texas congressional delegation, Dr. Fletcher told all of us that we should support NASA. Well, we have. Lyndon Johnson and Congressman Albert Thomas from Houston laid the first brick on the Space Program. The portrait on the wall over there to my right is Tiger Teague. He served in a long, lean district that runs north to south in Texas, and he was the first chairman of the Space Science Subcommittee. He served in that capacity for many years, and his replacement, Joe Barton, now proudly carries on that heritage.

The Texas delegation has supported the Space Program. We'll continue to do so. But we also have a higher responsibility, and that is to make sure that the program makes good economic sense, that the decisions are carefully thought out at this very critical time, that we not undermine the very integrity of the program that we're trying to rebuild.

I look forward to these hearings, and I look forward to this period of time when we can consult with one another and we can draw some conclusions that will be in the best interests of our Nation's Space Program.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Andrews follows:]

STATEMENT ON SPACE STATION REORGANIZATION SSA HRG Aug. 5. 1986

THANK YOU, MR. CHAIRMAN. LET ME SAY THAT I APPRECIATE YOUR ALLOWING ME TO PARTICIPATE IN THIS CRITICAL HEARING ON THE FUTURE OF THE SPACE STATION PROGRAM AND APPLAUD YOU FOR CALLING IT.

SINCE JANUARY 28TH, THIS COMMITTEE, DETAILED BY THE CONGRESS TO WATCH OVER AND GUIDE OUR NATIONAL SPACE EFFORT, HAS EXPERIENCED A REVOLUTION IN ITS APPROACH TO OVERSIGHT OF NASA. WE JOINED ALL AMERICANS IN THE GRIEF THAT FOLLOWED THE CHALLENGER ACCIDENT. LIKEWISE, WE SHARED IN THE SHOCK AND DISBELIEF AS THE ROGERS COMMISSION UNCOVERED SERIOUS AND PERSISTENT PROBLEMS IN THE WAY NASA RAN THE SHUTTLE PROGRAM. THOUGH THE ROGERS REPORT DID NOT SPECIFICALLY DISCUSS THE SCIENCE AND TECHNOLOGY COMMITTEE OR OTHER NASA PROGRAMS, OUR COMMITTEE'S REVIEW HEARINGS ON THE REPORT HAVE MADE IT QUITE CLEAR THAT OVERSIGHT OF NASA HAS TO BE ENHANCED IF WE ARE TO AVOID FUTURE ERRORS AND TRAGEDIES.

AS MEMBERS OF THE SCIENCE AND TECHNOLOGY COMMITTEE, THE ROGERS REPORT GAVE US A HEIGHTENED AWARENESS OF PROBLEMS AND GAPS IN OUR UNDERSTANDING OF WHAT NASA WAS DOING. WE LEARNED THAT WE COULD NO LONGER ACCEPT PAT ANSWERS TO CRITICAL QUESTIONS. WE NOW UNDERSTAND THAT IN ORDER TO PLAY OUR PROPER ROLE IN GUIDING NASA WE MUST CLOSELY CONSULT WITH THEM AND FULLY UNDERSTAND THEIR PLANS AND GOALS.

WITH THESE THOUGHTS IN MIND, I HAVE BEEN DEEPLY TROUBLED BY NASA'S HANDLING OF THE PROPOSED REORGANIZATION. AS WE HAVE RAISED SUBSTANTIVE QUESTIONS AND CONCERNS, NASA HAS RESPONDED FITFULLY AND COMPLAINED OF CONGRESSIONAL "INTERFERENCE". THAT ATTITUDE IS WRONG-HEADED AND WILL ONLY LEAD TO CONFLICT, NOT TO ACHIEVEMENT.

IT IS FROM THAT VANTAGE POINT THAT I, AND I BELIEVE MANY MEMBERS OF THIS COMMITTEE AS WELL, VIEW THIS ISSUE BEFORE US TODAY. WE MUST APPLY THE LESSONS OF CHALLENGER TO OURSELVES AND TO NASA OR WE ARE DOOMED TO REPEAT THAT TRAGEDY.

LET ME REVIEW NOW THE SUBSTANTIVE QUESTIONS THAT ARE UNRESOLVED AND WHICH MUST BE ANSWERED BEFORE WE CAN PROCEED.

I HAVE ALREADY TOUCHED ON THE PROCESS OR RATHER LACK OF PROCESS USED BY NASA IN ANNOUNCING THIS PROPOSED REORGANIZATION. ON JUNE 30, THIS DECISION WAS ANNOUNCED BY NASA HEADQUARTERS WITHOUT PROPER CONSULTATION WITH ANY MEMBERS OF CONGRESS OR THE STAFFS OF THE APPROPRIATE AUTHORIZING COMMITTEES. WHAT LITTLE INFORMATION WAS GIVEN OUT WAS ACCOMPANIED BY ASSURANCES OF THE INCONSEQUENTIAL NATURE OF THIS PROPOSAL. IT WAS NOT UNTIL MY MEETING WITH DR. FLETCHER AND CHAIRMAN NELSON ON JULY 15 THAT NASA BEGAN TO RELEASE PERTINENT DATA FOR OUR REVIEW. THE RESPONSE WE RECEIVED TO THESE INQUIRIES WAS A WARNING THAT RAISING THESE SIMPLE QUESTIONS AT THIS JUNCTURE WOULD "ENDANGER THE STATION". I SUBMIT THAT IF THE STATION PROGRAM COULD NOT WITHSTAND THIS EXAMINATION THIS EARLY IN THE PROGRAM THEN PERHAPS THE PROBLEMS ARE MORE SERIOUS THAN WE THOUGHT.

MY CONCERNS HAVE BEEN INCREASED BY THE CONFUSION AND CONFLICTING INFORMATION THAT HAVE CLOUDED OUR LEGITIMATE DISCUSSIONS. FOR INSTANCE, WITHIN THE LAST TWO WEEKS NASA HAS CONFIRMED THE VALIDITY OF THREE DIFFERENT SETS OF STATISTICS ANALYZING THE PERSONNEL AND ECONOMIC IMPACT OF THIS ORDER ON HOUSTON. REGRETTABLY, NO SUCH ANALYSIS WAS PERFORMED PRIOR TO THE JUNE 30 DECISION.

ON ECONOMIC QUESTIONS, DR. FLETCHER SAID IN HOUSTON THAT NASA "IS NOT AN ORGANIZATION THAT GIVES WORK OUT TO PEOPLE UNDER DISTRESS." IN ADDITION HE STATED THAT "THERE IS NO REQUIREMENT" TO CONSIDER THE LOCAL ECONOMIC IMPACT OF HIS DECISION. SUCH A "REQUIREMENT" MAY NOT BE STATED IN FEDERAL REGULATIONS; IT REALLY SHOULD NOT HAVE TO BE. IT IS UNTHINKABLE NOT TO CONSIDER THE ECONOMIC EFFECT OF SUCH A SIGNIFICANT CHANGE ON A LOCAL COMMUNITY.

HOWEVER, BEYOND THIS LOCAL IMPACT THAT NASA IS NOT CONCERNED ABOUT, WHAT ABOUT THE DEVELOPMENT OF THE COMMERCIAL POTENTIAL OF SPACE WHICH IS ONE OF OUR NATION'S MOST IMPORTANT GOALS. THE UNIQUE MANNED SYSTEMS EXPERTISE AND FACILITIES AT JSC HAVE ATTRACTED INDIVIDUALS AND COMPANIES FROM AROUND THE WORLD TO HOUSTON. THIS MAJOR SHIFT IN ORGANIZATION WILL GREATLY EFFECT THEIR EFFORTS AND INVESTMENTS AND SHOWS AN INSENSITIVITY AT NASA HEADQUARTERS TO THE NEED TO NURTURE THESE RESOURCES AND POTENTIAL.

THIS SERIES OF ACTIONS AND STATEMENTS COMING FROM THE LEADERSHIP OF NASA CONCERNS ME GREATLY.

DESPITE THIS CONCERN, I WAS ENCOURAGED THAT DR. FLETCHER AGREED TO CEASE IMPLEMENTATION OF THE ORDER UNTIL IT WAS REVIEWED BY CONGRESS AND AGAIN BY NASA. HOWEVER, MY CONCERN WAS INTENSIFIED WHEN LAST FRIDAY IN HOUSTON HE STATED THAT HIS DECISION WOULD NOT BE CHANGED. WHAT IS THE POINT OF A "REVIEW" WHEN THERE IS NO WILLINGNESS TO ACCEPT ANY POTENTIAL CHANGES.

ON TECHNICAL GROUNDS, IT HAS BECOME APPARENT THAT NASA ANNOUNCED THIS DECISION WITHOUT FULLY CONSIDERING THE MANY EFFECTS THAT WOULD RESULT AND THE NUMEROUS QUESTIONS IT WOULD RAISE. THERE APPEAR TO BE SERIOUS FLAWS IN AN ORDER THAT MOVES THE RESPONSIBILITY FOR PROPULSION DEVELOPMENT AWAY FROM THE PROPULSION EXPERTS AT THE MARSHALL SPACE FLIGHT CENTER AND THE RESPONSIBILITY FOR MANNED SYSTEMS DEVELOPMENT AWAY FROM THE ACKNOWLEDGED WORLD-CLASS MANNED SPACE EXPERTS AT JOHNSON SPACE CENTER.

IN SHIFTING THESE ROLES, NASA HAS IGNORED THE TREMENDOUS DISLOCATION AND DISRUPTION THAT COULD RESULT FROM IGNORING THE ENORMOUS CAPITAL AND HUMAN INVESTMENT SPENT IN DEVELOPING THESE CENTERS OF EXPERTISE. FOR EXAMPLE, THE DEVELOPMENT OF MANNED SPACE SYSTEMS AT MARSHALL WOULD STILL HAVE TO RELY ON THE TECHNICAL EXPERTISE AT JOHNSON, ON THE TREMENDOUS TEST BEDS THAT EXIST AT JOHNSON TO DO THE JOB, AND ON THE ASTRONAUTS AT JOHNSON TO CONSULT ON THE HUMAN INTERFACE.

IN SHIFTING THESE ROLES, WE WOULD IGNORE THE DESIGN PROBLEMS AND LOGISTICAL DISRUPTIONS THAT OCCURRED IN THE SKYLAB PROJECT, ONE OF THE FEW INSTANCES WHERE MARSHALL DEVELOPED A MANNED SYSTEM. HAVE WE LEARNED NOTHING FROM THAT EXPERIENCE?

MOREOVER, THERE ARE LONG-TERM IMPLICATIONS THAT NO ONE AT NASA TO MY KNOWLEDGE HAS PROPERLY ADDRESSED. IF THE MANNED SPACE SYSTEMS DEVELOPMENT IS CONSOLIDATED AT MARSHALL, IT SEEMS APPARENT THAT OVER TIME THE CREW OPERATIONS FOR THE STATION WILL BEGIN TO GRAVITATE TOWARD MARSHALL. THE ORDER DOES NOT DISCUSS THIS QUESTION. IN FACT, JOHN HODGE BEFORE THIS SUBCOMMITTEE A FEW DAYS BACK DENIED THAT THAT POSSIBILITY WAS UNDER CONSIDERATION.

I AM FRANKLY DISTURBED THAT THESE POINTS HAVE NOT BEEN CONSIDERED. JUST GLANCING OVER THESE CHANGES GIVES ME A FEELING THAT THE TREND LINE IS FAIRLY CLEAR. WHEREVER THE MANNED SYSTEMS GO, THE ASTRONAUTS AND PERHAPS FLIGHT OPERATIONS AND MISSION CONTROL WILL FOLLOW EVENTUALLY. HOW CAN YOU SUGGEST DECISIONS SUCH AS THIS WITHOUT DOING A FULLER ANALYSIS OF THE COSTS, IMPLICATIONS, AND LONG-TERM IMPACTS? WE NEED THAT KIND OF INFORMATION.

OVERALL, THE JUNE 30 PROPOSAL REPRESENTS A CHANGE IN PHILOSOPHY ON HOW WE WILL BUILD THE STATION AND WHAT ROLE THE FIELD CENTERS WILL HAVE OVER THE COMING YEARS. SUCH AN IMPORTANT CHANGE MUST BE CONSIDERED BY CONGRESS.

TAKEN TOGETHER, THESE ISSUES HAVE THE POTENTIAL TO CONFUSE THE STATION PROGRAM AND SIGNIFICANTLY INCREASE THE TOTAL COST OF THE SYSTEM, POSSIBLY ENDANGERING ITS COMPLETION. THESE ARE THE QUESTIONS WE MUST ANSWER--NOT WHETHER NASA FEELS PARTICULARLY HARASSED OR INCONVENIENCED BY HAVING TO DISCUSS THIS WITH CONGRESS. EVERY MEMBER OF THIS SUBCOMMITTEE, AND MOST MEMBERS OF THE CONGRESS, WANT THE SPACE STATION; BUT THEY ALSO WANT A COST-EFFECTIVE, SUCCESSFUL, AND SAFE STATION. WE BECOME CONCERNED WHEN NASA CONTINUES TO APPROACH PROBLEMS WITH A MENTALITY THAT IS DEFENSIVE AND COMBATIVE, RATHER THAN OPEN AND COOPERATIVE.

AS A NATION, WE ARE BUILDING A SPACE STATION THAT WILL BE THE WONDER OF THE WORLD; BUT WE ARE BUILDING IT WITH TAXPAYER DOLLARS WHICH MEANS CONGRESS HAS A PROPER ROLE. WE MUST WORK TOGETHER, NASA AS THE STOREHOUSE OF OUR NATION'S GREATEST SCIENTIFIC AND ENGINEERING MINDS AND CONGRESS AS THE REPRESENTATIVES OF THE PEOPLE.

THANK YOU, MR. CHAIRMAN.

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Mr. NELSON. Thank you, Mr. Andrews.

Next in order of seniority is our colleague, a member of the committee, the Honorable Joe Barton.

STATEMENT OF HON. JOE BARTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. BARTON. Thank you, Mr. Chairman. I'd like to thank my colleague from Houston for those kind remarks. Our committee's loss is the Ways and Means Committee's gain. I'm sure you'll do a fine job on that committee, Mike.

Mr. Chairman, I'm pleased that the subcommittee has convened this hearing to investigate the recent NASA proposal regarding Space Station management. Our Space Station Program is one of the most vital research and development efforts being undertaken by NASA at the present time. The recent Soviet advances on their space station make it even more critical that the United States program remain dynamic and structurally sound.

The current NASA proposal that we're reviewing today was formulated without congressional oversight and involves fundamental policy changes in the Space Station Program. In the weeks since the announcement of the program, NASA officials have attempted to explain the purpose and rationale behind the proposed transfer. Mr. Chairman, they have failed. There are a great number of questions which remain to be answered.

This proposal appears to have been undertaken with a minimum of analysis and review. NASA has been unable to determine the cost of the proposal, the number of jobs affected, the impact on the management structure, and the changed requirements on the prime contractors. These issues have been further confused by the variety of estimates which have emanated from various NASA offices. It's disturbing that a decision of this magnitude was made without making the most basic estimates of the effects the proposal will have.

Mr. Chairman, as a strong supporter of our Space Program, I am committed to seeing that we solve the current problems at NASA and resume space flight to ensure our world leadership in space exploration. I look forward to working with you, Dr. Fletcher who is here today, and others that are concerned about our Space Program to resolve these issues in this hearing and subsequent hearings if necessary.

Mr. NELSON. Thank you, Mr. Barton.

Well, Mr. DeLay, please come up to the—there are disadvantages to being junior.

STATEMENT OF HON. TOM DeLAY, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. DELAY. And hazards of being a freshman. And I appreciate those hazards of being a freshman, Mr. Chairman.

I won't take a whole lot of your time.

Mr. NELSON. We're delighted. Let me just formally introduce you, our colleague from Texas, the Honorable Tom DeLay.

Mr. DELAY. Thank you, Mr. Chairman, and I, too, thank you for holding this hearing, this very timely hearing, and I won't take

much of your time because I think everything that should be said has been said, but I would like to enter my statement into the record at this point, if you don't mind, and just make a couple of statements about what has been said and my own feelings.

I don't think any one of us in the Houston delegation, notwithstanding the Texas delegation, has ever questioned the management decisions being made by NASA as far as centralizing management in the District of Columbia area. That management decision is going to cost somewhere around 300 jobs from JSC to Washington, DC, and I think most of us support that management decision and understand it through all of the studies that have been done that that is necessary for the efficiency of NASA.

But what we are questioning is a decision that should have been a proposal, a decision that was made, and, frankly, we have yet to get the reason why. In private meetings, the question again and again has been asked, why this decision? Hopefully, Mr. Chairman, you'll get that answer today.

As far as an answer to the question of who is in charge, it is my experience in the legislative process and as an American citizen that Congress is in charge, and for Congress not to have been consulted on this decision, I think, opens up a world of questions.

So, I would just like to say and point out in my final remarks, Mr. Chairman, and concluding remarks in my statement, I do thank this subcommittee for this opportunity. I hope you will, and I know you will, carefully consider NASA's proposal, its effects on our community, and its effects on morale, and, most importantly, its effects on our whole program of a manned space center.

I, for one, if I can be convinced by NASA that this is a decision that enhances the efficiency of NASA, will support the decision. Being a Member from Houston, TX, the oil and gas capital of the world, and against the oil import fee, I think I've demonstrated my capability of making either stupid political decisions or making decisions based upon what is right.

But let me just close with this one thought. In a conversation with former astronaut Deke Slayton just today, he said to me, "No doubt that Johnson was and still is where manned space flight takes place, and it seems to me somewhat irrational to move it." I wholeheartedly agree with that, and I thank you, Mr. Chairman.

[The prepared statement of Mr. DeLay follows:]

STATEMENT BY MR. DeLAY (R-TEXAS 22) BEFORE THE SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

AUGUST 5, 1986

MR. CHAIRMAN, I AM ALSO GRATEFUL FOR THE OPPORTUNITY TO EXPRESS MY CONCERNS ABOUT THE PROPOSED REORGANIZATION OF NASA -- SPECIFICALLY THEIR PLANS TO MOVE PART OF THE WORK ON THE SPACE STATION FROM JOHNSON SPACE CENTER IN HOUSTON TO THE MARSHALL SPACE FLIGHT CENTER IN HUNTSVILLE, ALABAMA.

IT SEEMS TO ME THAT NASA HAS PUT A 90 DAY HOLD ON PLANS THAT AMOUNT TO A MAJOR MISTAKE -- AND IT'S CONGRESS' JOB TO MAKE SURE THAT NASA ISN'T ALLOWED TO MAKE THAT MISTAKE. THE PROPOSAL ACCORDING TO NASA IS TO SHIFT RESPONSIBILITY FOR THE HABITATION MODULE AND AIRLOCK AWAY FROM JSC TO MARSHALL SPACE FLIGHT CENTER. FURTHER, THE RESPONSIBILITY FOR OUTFITTING THE HABITATION MODULE WAS SHIFTED TO THE CENTER THAT IS DEVELOPING THE MODULE STRUCTURE -- OR SHELL -- BECAUSE THEY SAY SUCH A MOVE WILL INCREASE EFFICIENCY AND SIMPLIFY MANAGEMENT COMMUNICATION, COORDINATION AND DECISION-MAKING. THIS PLAN WOULD MAKE SENSE -- PUTTING TOGETHER THE WHOLE PACKAGE AT ONE LOCATION -- IF THEY CHOSE THE LOGICAL LOCATION. THE QUESTION I HAVE -- AND MORE IMPORTANTLY -- MY CONSTITUENTS HAVE, IS -- WHY WAS THE DECISION MADE TO SEND THE WORK FOR THE GUTS OF THE HABITATION MODULE TO THE SHELL -- INSTEAD OF HAVING THE SHELL SENT TO THE GUTS?

I SAY, "SENT TO THE GUTS" -- BECAUSE THAT IS WHAT JOHNSON HAS ALWAYS DONE -- THE GUTS -- THE HEART AND SOUL OF MANNED SPACE FLIGHT. ALSO, WE MUST CONSIDER THAT JOHNSON SPACE CENTER IS WHERE OUR ASTRONAUTS ARE. HOW CAN WE SEPARATE THE SYSTEM FROM THE VERY PEOPLE WHO NEED TO HAVE INPUT INTO THAT SYSTEM, WHICH THEY WILL DEPEND ON FOR THEIR COMFORT AND, OF COURSE, THEIR SURVIVAL. AS A REPRESENTATIVE FROM HOUSTON I LOOK AT THE ACCOMPLISHMENTS OF THE JSC WITH A GREAT SENSE OF AWE AND PRIDE. LET ME TELL YOU JUST SOME OF THEIR ACCOMPLISHMENTS IN MANNED SPACE FLIGHT OVER THE YEARS:

DURING THE MERCURY, GEMINI, AND APOLLO PROGRAMS, THE MANNED SPACECRAFT CENTER, AS IT WAS THEN CALLED, WAS ASSIGNED RESPONSIBILITY FOR MANAGEMENT OF THE DESIGN OF THE MANNED SPACECRAFT AND ITS CREW-RELATED SYSTEMS AND CAPABILITIES. THESE INCLUDED:

* THE ENVIRONMENTAL CONTROL SYSTEMS; MAINTAINING A PURE, PRESSURIZED AIR SUPPLY, REMOVAL OF CO2, TEMPERATURE CONTROL, DETECTION AND/OR ELIMINATION OF TOXIC CONTAMINANTS --

* SPACE SUITS --

* FOOD SYSTEMS; THE FOOD ITSELF, THE PACKAGING AND SERVING HARDWARE, AND MAINTENANCE OF PURITY --

* WASTE MANAGEMENT SYSTEMS AND CREW PERSONNEL HYGEINE EQUIPMENT * ALL CREW CLOTHING --

* POST-LANDING SURVIVAL EQUIPMENT --

* CREW SEATS AND RESTRAINTS --

* CONTROLS, DISPLAYS, CAUTION AND WARNING SYSTEMS, COMPUTER SOFTWARE AND DISPLAYS, THE WHOLE MAN-MACHINE INTERFACE --

* COMMUNICATIONS EQUIPMENT --

* MEASUREMENT OF, AND PROTECTION FROM RADIATION --

* IN-FLIGHT MEDICAL CARE --

* AS THE SKYLAB PROGRAM DEVELOPED, JSC WAS RESPONSIBLE FOR MOST SYSTEMS IN THE HABITABILITY SYSTEM, INCLUDING FOOD MANAGEMENT, WASTE MANAGEMENT, PERSONAL HYGEINE AND SLEEP RESTRAINTS

* AND, JSC AGAIN EARNED THE RESPONSIBILITY FOR MANAGEMENT OF CREW ACCOMODATIONS FOR THE SHUTTLE PROGRAM.

OBVIOUSLY, JOHNSON SPACE CENTER HAS A LONG AND DISTINGUISHED RECORD IN MANNED SPACE FLIGHT. CAN THE SAME BE SAID OF MARSHALL SPACE FLIGHT CENTER? THEY HAVE A LONG AND DISTINGUISHED RECORD, BUT THAT'S IN PROPULSION NOT IN MANNED SPACE FLIGHT SYSTEMS. WHY START FROM SCRATCH NOW?

COULD IT BE THAT NASA FELT THAT THE ROGERS COMMISSION COMPELLED THEM TO TAKE SUCH A STEP THROUGH THEIR RECOMMENDATIONS? I DON'T THINK THAT IS THE CASE. LET ME READ FROM RECOMMENDATION NUMBER FIVE FROM THE COMMISSION REPORT: "NASA SHOULD TAKE ENERGETIC STEPS TO ELIMINATE THIS TENDENCY (MANAGEMENT ISOLATION) AT MARSHALL SPACE FLIGHT CENTER, WHETHER BY CHANGES OF PERSONNEL, ORGANIZATION, INDOCTRINATION OR ALL THREE." CAN THIS RECOMMENDATION BE INTERPRETED TO MEAN THAT KEY ELEMENTS FROM NASA'S MOST IMPORTANT PROGRAM SHOULD BE MOVED FROM THE INSTALLATION THAT HAS ALWAYS DONE THAT TYPE OF WORK? OF COURSE NOT. CHANGES NEED TO BE MADE AT MARSHALL -- WITHIN MARSHALL, THEY CERTAINLY DON'T NEED THE INFUSION OF NEW PROGRAMS AND

PERSONNEL -- AND THE JOHNSON SPACE CENTER CERTAINLY DOES NOT NEED TO LOSE A PROGRAM IN THEIR AREA OF EXPERTISE.

AGAIN I THANK THE SUBCOMMITTEE FOR THIS OPPORTUNITY. I HOPE YOU WILL CAREFULLY CONSIDER NASA's PROPOSAL -- ITS EFFECTS ON COMMUNITIES, ITS EFFECTS ON MORALE, AND MOST IMPORTANTLY -- ITS EFFECTS ON OUR WHOLE PROGRAM OF MANNED SPACE FLIGHT. LET ME CLOSE WITH THIS ONE THOUGHT -- IN A CONVERSATION WITH FORMER ASTRONAUT "DEKE" SLAYTON, HE SAID TO ME, "NO DOUBT THAT JOHNSON WAS AND STILL IS WHERE MANNED SPACE FLIGHT TAKES PLACE, AND IT SEEMS TO ME SOMEWHAT IRRATIONAL TO MOVE IT". I WHOLEHEARTEDLY AGREE. THANK YOU.

Mr. NELSON. Thank you, Mr. DeLay.

Dr. Fletcher, that's about one of the longest introductions you've ever had, isn't it?

Dr. FLETCHER. I think so.

Mr. NELSON. Dr. Fletcher, it's your pleasure. We will be hearing, of course, from General Phillips, Mr. Stofan, and Mr. Aaron for anything that he has to add. Would you like them seated with you at the table at this point?

Dr. FLETCHER. That would be helpful, Mr. Chairman. Yes.

Mr. NELSON. OK. If all of you would, then, join Dr. Fletcher.

By my timing, that was about 1 hour and 25 minutes introduction.

Dr. FLETCHER. That's pretty long, Mr. Chairman.

Mr. WALKER. I think we can assume that the eyes of Texas are upon you.

Mr. NELSON. That's well said by a Pennsylvania Dutchman.

Mr. ANDREWS. Mr. Chairman.

Mr. NELSON. Yes.

Mr. ANDREWS. I'd like to ask unanimous consent to submit my written statement for purposes of the record, please.

Mr. NELSON. Certainly. All members will have that opportunity. For whatever written statements they want to add to the record, they're welcome to have at it. You're most welcome.

OK, Dr. Fletcher, thank you for being with us. You may proceed, and then we'll go to General Phillips.

STATEMENT OF JAMES C. FLETCHER, ADMINISTRATOR, NASA, WASHINGTON, DC

Dr. FLETCHER. Mr. Chairman, as you pointed out, we are here today to try to clarify some of the issues that have been raised but certainly not all. We will do our best to answer questions when they come.

As you mentioned, NASA does have an obligation to keep Congress fully informed of its activities. If it's all right with you, Mr. Chairman, I would like to submit my statement for the record and just kind of talk generally to the statement, if that's all right with you, sir.

Mr. NELSON. Without objection.

Mr. FLETCHER. Hopefully, this hearing will clarify what we have proposed to do and in part respond to your very legitimate desires to be completely—to make you completely aware of what NASA plans to do.

As was mentioned earlier, space has been a success story for this country. I wouldn't be back here, Mr. Chairman, if that weren't the case. I believe it will continue to be so.

As we approach a new century, the United States must regain its position of leadership in space. President Reagan remains fully committed to the development of a permanently manned space station. It is absolutely essentially that we—that is, the Congress, NASA, and the executive branch of Government—move forward in this direction.

The Space Station Program has gone reasonably well, but it became clear that the work packages needed to be modified and

the management needed to be restructured. Your letter of July 14 expressed interest in and concern with recent management decisions. These decisions were taken in the context of three significant events actually mentioned by Mr. Flippo earlier.

First, we had the Rogers Commission report. Second, we had a general review of all of NASA's programs but starting with the space station by Gen. Sam Phillips and his task force, and I might add, Mr. Chairman, at this time, that General Phillips didn't sign up for this kind of a meeting, he signed up to help me, advise me, on how to manage NASA better, but he is a volunteer here, not a draftee, if I might say so, and he ought to have your thanks and support for being here.

In addition to General Phillips' review, there were extensive phase B studies that tested both work packages and management structure. Let me quickly review these management decisions. A new Program Office in the Washington area was to be set up to conduct the systems engineering and analysis function. This Office was to be headed by a program Director who would report to the Space Station Associate Administrator who is here today, Andy Stofan. This Office will have a responsibility for operations planning and will be supported by a support contractor.

Now, the rationale for these management decisions were simple: To centralize program management in Washington, which would improve communications, program control, and, by the way, I'll add communications with Congress as well as with the rest of NASA, which is a fringe benefit, but that wasn't the original idea; program control and accountability. It's absolutely essential to have new management structure in place before we begin phase C/O, which should start in next calendar year.

Now, let me briefly comment upon the work package decisions which is, I guess, the main subject of this hearing. Some changes were made to eliminate overlap between the various centers' responsibilities and between the various proposed hardware contractors' responsibilities. The primary rationale was to assure accountability for the delivery of space station elements that are to be launched in space.

Accountability is key to technical success and cost control, and I speak with some authority of my own, having been involved in the Space Program and many other programs over the years, starting back in 1954 when the ICBM Program first started, but I must add that Sam Phillips, sitting next to me, has had considerably more.

Last week, I announced that NASA would hold off any work package decisions for up to 90 days and that in response to concerns with the space station configuration we would review all aspects of space station design. I expect to consult with you and the rest of Congress before taking any actions on the work packages and to keep you advised of the design review.

Now, just to wind up, Mr. Chairman, I'm confident that the Johnson Space Center will continue to play a major role in the Space Station Program. This role is likely to be even larger, because some of the analysis to be accomplished at the new Washington Program Office will be contracted back, in a sense, to the Johnson Space Center.

Of course, the Johnson Space Center will remain at the forefront of the Space Shuttle Program. The Shuttle Program will require the technical expertise of Johnson for many years to come. This key role in manned space transportation systems, combined with a significant central role in the Space Station Program, will assure Johnson's preeminence in manned space flight. Houston will be perceived in the future still by most people in the world as synonymous with space.

Mr. Chairman, that concludes my prepared statement, and I'll yield to General Phillips, if that's your desire.

[The prepared statement of Mr. Fletcher follows:]

NASA
National Aeronautics and Space Administration

Hold for Release Until
Presented by Witness
August 5, 1986

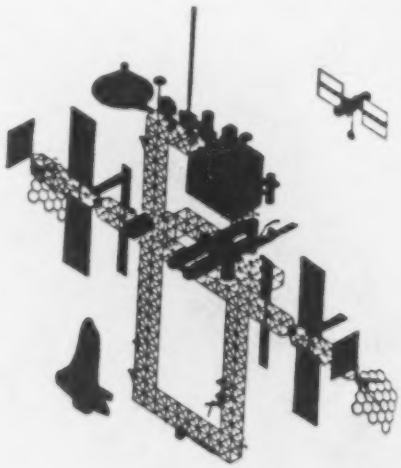
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

Statement by:

Dr. James C. Fletcher
Administrator



99th Congress

Statement of

Dr. James C. Fletcher

Administrator

National Aeronautics and Space Administration

before the

Subcommittee on Space Science and Applications
Committee on Science and Technology
House of Representatives

Mr. Chairman and distinguished Members of the Subcommittee:

I am here this afternoon in response to your letter of July 29th inviting me to testify on recent decisions pertaining to the management of the Space Station Program. I welcome this opportunity to discuss these decisions with you and to explain their rationale.

As you know, last week I announced that, in view of the need for greater consultation with Congress, NASA would hold off implementing any "work package" realignment and that I would review all aspects of Space Station design. Your letter of July 14, co-signed by Rep. Walker, expressed great interest in our plans to restructure the Space Station Program and pointed out their substantial nature. I hope this hearing will clarify what our plans are in this regard and will help keep this Subcommittee fully informed of our Space Station activities.

Accompanying me today is General Samuel Phillips, who led a small team of distinguished and experienced individuals in a review of the Space Station program management; Mr. Andrew J. Stofan whom I've recently appointed as NASA Associate Administrator for Space Station; and Mr. John Aaron, Acting Space Station Program Manager at the Level B Program Office at the Johnson Space Center in Houston. Each of these individuals is extremely well versed on the management decisions taken. Together we hope to be able to provide you with a thorough explanation.

Let me again publicly thank Sam Phillips and his team for their fine work. General Phillips is a proven manager with enormous experience. He has served both NASA and the Air Force with distinction and has worked at the highest level in private industry. His review of the Space Station management structure was extremely helpful.

With your permission, I will speak first this afternoon, with brief remarks based on a short prepared statement that I would

like to have made part of the hearing record. General Phillips will then describe his study and his recommendations, and will be followed by Mr. Stofan. Mr. Stofan will comment on how he would implement these management decisions and how he expects to conduct a thorough review of "work packages" and Space Station design.

Before we begin, it might be useful to first comment upon what NASA overall priorities are, in order to better understand the context of the Station decisions.

The loss of Challenger and its crew of seven was a tragic and disheartening setback to our space program, which was deeply felt by the men and women of NASA. The loss has occasioned a searching and sometimes painful inquiry into our policies and practices, from which I am convinced we will emerge a stronger, steadier agency. As we reshape NASA and rebuild our program, we will look to the outside and to this Subcommittee in particular for guidance and assistance. The goal we share is a vigorous, bold, yet balanced civil space program that is both worthy of our heritage and meets the expectations of the American people.

Space has been a success story for this country. I believe that it will continue to be so. As we approach a new century, the United States must regain and hold firmly the banner of space leadership.

Our priorities are clear. We must resolve our difficulties with the Space Shuttle and assure a return to safe and dependable flight operations. All of us are anxious to fly again as soon as we can, but the Shuttle will not fly until we are confident it can be done safely. We must proceed with the Space Station for it will be the future centerpiece of our space program and the building block for our activities at the beginning of the 21st Century. We must rededicate our commitment to space science and applications, an activity that by challenging our intellect increases our knowledge and enhances our standard of living. We must provide for a launch capability that meets our substantial and diverse requirements. We must pursue the technological basis for a future National Aerospace Plane which offers the potential for quantum advances in various regimes of flight. And, as we do all this, we must concurrently maintain the technical capability as well as the institutional vitality of NASA for they are essential to realizing our programmatic goals.

The goal of developing a permanently manned Space Station is one to which the Administration remains committed. Since the President's historic directive to NASA in January, 1984, NASA has set in place a substantial program. This program involves user requirements, technology development, operations planning, and systems design. U.S. industry is committed to the program and is hard at work. Canada, Europe, and Japan are participating and we expect the Space Station to have a strong international flavor.

Much progress has been made. While the technical analysis done so far has been substantial, concerns about the current Space Station configuration have been raised. So I have directed Mr. Stofan to review all aspects of Space Station design. We will share the results of his analysis with you. My goal, which I'm sure you share, is a Space Station that is versatile, useful, safe and affordable. And at the same time it must be sufficiently substantial to challenge our technical ingenuity and demonstrate our commitment to fully exploiting the potential of space.

As the Space Station Program matured, it became clear that its program management needed to be restructured. This was not totally unexpected for the initial organizational structure of large complex aerospace projects traditionally evolve over time, just as the technical parameters of such projects change. Next year the Space Station Program will enter the Phase C/D detailed design and development phase. It is imperative that a strong and stable organization be in place to firmly manage the program during this critical stage.

To assure that such an organization is established, I recently made a number of fundamental management decisions. These decisions involve organizational structure, managerial processes, allocation of responsibilities among NASA installations and key personnel.

In making these decisions I solicited and benefited from the advice and wisdom of many individuals. I listened to senior representatives of the contractor community, to NASA Center Directors, to senior officials here at Headquarters, to several Space Station Program officials and to others as well. But I wish to emphasize that the decisions were mine, and mine alone. They were inherent in the responsibility given to me by President Reagan when he appointed me the Administrator of NASA.

It should be remembered, though, that these Space Station management decisions were not made in isolation. They were made in the context of three significant events:

- The Presidential Commission investigating the Challenger tragedy recommended that NASA overhaul its management structure and processes and strengthen the role of NASA Headquarters.

- An independent review of the Space Station organization by a team of experienced aerospace managers, led by General Samuel Phillips, recommended fundamental changes to the organization.

- The extensive Space Station Phase B study we initiated has tested management approaches as well as technical design questions. As we began Phase B we anticipated that changes to work packages and restructuring of Space Station organizational units would occur as we gained a better

understanding of the managerial dimension of the Space Station Program.

Let me now briefly review the decisions that have been made. To conduct the systems engineering and analysis function, a new Space Station Program Office will be established in the Washington, D.C. area. This office will replace the current Level B Office and be responsible for program management and for the technical integration of various Space Station systems and elements. This new Program Office will be headed up by a Program Director who will report to the Associate Administrator for Space Station at NASA Headquarters. The office will have a principal responsibility for planning Space Station operations and, in its technical work, be assisted by a hardware support contractor. In establishing this new office, we are in effect departing from the "lead center" approach to Space Station program management. By not being coupled to any one particular center, the new program office will be able to enjoy an objectivity and independence that will benefit both the technical and managerial aspects of the program. The complex task of overall Space Station engineering, of making sure that the best technical choices are made and that the many different pieces fit smoothly into one integrated system, will be better accomplished by this new structure. And by centralizing program management in Washington, we are following a key recommendation of the Rogers Commission and will be able to improve communications, program control, and accountability.

Another set of decisions dealt with the "work packages". These are the segments of the Space Station work that are distributed among various NASA centers. In examining the allocation of work, I found it necessary to alter the work packages. For example, the Space Station propulsion system is planned to be moved from Work Package #1 at the Marshall Space Flight Center to Work Package #2 at the Johnson Space Center. Responsibility for outfitting the habitat module is planned to be shifted to the Marshall Space Flight Center from the Johnson Space Center. Many of the proposed changes were made to eliminate overlap. But the primary rationale for the work package proposals was to achieve clarity in accountability for delivered end items. Contractors - and the associated Centers - must be clearly accountable for the delivery of a Space Station element that is to be launched into space. Accountability is, I believe, the key to assuring both technical success and proper cost control.

In response to a number of concerns and questions regarding these work packages, I intend to review the whole question of work packages in detail and will hold off taking decisions prior to consulting with you and other interested Members of Congress.

I am confident that each Center will have a significant amount of work. Johnson, for example, should be responsible for the overall Space Station structure and for the assembly of the Station itself. It would retain responsibility for several key

integrating systems, including data management; guidance navigation and control; and communications and tracking. Johnson also would retain responsibility for major aspects of software development and for interfaces with the Space Shuttle.

I should note that while overall programmatic responsibility for outfitting the habitat module would be shifted to the Center at Huntsville, technical direction of the outfitting would remain in Houston with the Johnson Center. Testbeds and mockups would remain at Johnson, as would research and development activities. I do not expect any substantial number of Johnson personnel would have to move from the Houston area on account of the outfitting decision.

I am confident that the Johnson Space Center will continue to play a major role in the Space Station Program. This role is likely to be even larger because some of the analysis to be accomplished at the new Washington program office will be "contracted back" to Johnson.

Of course, the Johnson Space Center will remain at the forefront of the Space Shuttle program. The Shuttle program will require the technical expertise of Johnson for some time. This key role in manned space transportation systems combined with a significant, central role in the Space Station Program will assure Johnson's preeminence in manned space flight. "Houston" still will be synonymous with space.

Mr. Chairman, that concludes my prepared statement.

Mr. NELSON. Thank you, Dr. Fletcher.

General Phillips, do you want to move that model just a little bit to the side there? Thank you.

STATEMENT OF GENERAL SAMUEL PHILLIPS, USAF, RETIRED, CONSULTANT, NASA HEADQUARTERS, WASHINGTON, DC

General PHILLIPS. Chairman Nelson and members of the subcommittee, I have, as you requested, submitted a prepared statement, and it will be available for the record. However, since my recommendations to Dr. Fletcher seem to be at the core of much controversy, with your indulgence, I would like to go through the bulk of the statement that I've prepared here for you today.

Mr. NELSON. Pull it closer—pull the microphone, please.

General PHILLIPS. This last April, I was asked initially by Mr. John Hodge, the Acting Associate Administrator of NASA for the space station, and subsequently by Dr. Jim Fletcher, to review the organization and the assignment of responsibilities in the Space Station Program. I was willing to do so as a private citizen recently retired from industry because of my strong belief in the importance to this country of the Nation's Space Program, and if John Hodge and Dr. Fletcher thought that I could advise in a constructive way, I was willing to devote the effort to do so.

Now my charter was to formulate recommendations by the end of June. My specific objectives included a review of the management structure, the distribution of work between the field centers, any resulting changes to interfaces, and NASA's plan for in-house system engineering and integration. I was not asked to review the technical design of the space station, and therefore I and the committee that I assembled to help me did not evaluate the current design of the space station.

Now our process involved lengthy interviews here in Washington at NASA headquarters, with the Program Office at the Johnson Space Center headed by John Aaron, and with the project officers at each of the five field centers that are involved in the program. At each of the field centers we spent time with the center Director, with the project office, and also spent several hours independently with each of the major contractors that had been working in the phase B part of this program.

Now prior to our review, there were several ground rules on which the phase B definition of the space station was based. The Johnson Space Center had been designated as the lead center, which meant that the five field center space station project officers would report directly to the project office at the Johnson Space Center. Now in this arrangement, NASA would act as, in effect, its own prime contractor and accomplish much of the system engineering and some of the system integration in house.

Now the Space Station Program has been a major NASA activity since 1982. Early configuration options were developed by a group of people and assembled here in Washington in 1982 and 1983, which was further refined in an effort here by an assembled group in 1984. That work culminated in the fall of 1984 in the release of a request for proposals for the definition and preliminary design of the space station.

Now in preparation for this release, work assignments were made to the NASA centers and were described in detail in the request for proposal and subsequently reflected in those phase B contracts. Because the space station configuration was still evolving at that time and because the allocation of functions among the space station elements still required the conduct of several trade-off studies to determine their optimum assignment, several areas of overlap were contained within the work assignments.

Now further, during 1985 and into this year, as the definition work proceeded additional areas of overlap developed that needed resolution. Now in the middle of May, John Hodge, as the Acting Associate Administrator for the Space Station Program, issued a directive resolving much of the overlap among the field center work assignments. The directive anticipated that the remaining actions would be defined and implemented upon the completion of my committee's tasks.

Now the Space Station has a very complex infrastructure. It has many elements in Earth orbit and several elements on the ground to support launch preparation and checkout, to plan and support flight operations, and to receive and distribute data from investigations that are conduct aloft.

Now throughout these elements are interwoven the subsystems that are necessary to run the space station and to provide services to its many users. Because of the size and because it cannot all be produced and launched at once, the space station will need to be assembled and hence checked out in orbit. Now that's a new element and an important element in the Space Program. It will be maintained on orbit through the continuous resupply of consumables and the exchange of experiments, and it will also be repaired on orbit. Due to its indefinite lifetime, the station, both the manned base and the unmanned platforms, must be periodically modified to incorporate significant advances in technology and to provide improved and increasing user services.

The organizational participation in the program is extensive. Within NASA, there are five field centers that are involved in a major way in the design and development efforts. There are Goddard, Johnson, Kennedy, Lewis, and Marshall, the five principal centers involved. Three program offices will provide science and experiments. These are aeronautics and space technology, commercial programs, and space sciences and application. Two program offices will provide direct support—the Office of Space Flight and the Office of Space Tracking and Data Systems—and will be joined internationally by Canada, the European Space Agency representing 12 member countries, and by Japan.

Now all of these considerations contribute to the management challenge of the program.

Now as my committee began its review, we found that two driving forces exist in the program. The first, directed by the President in his State of the Union Address in January of 1984, is to establish a permanently manned capability by 1994. The second is the strong realization within NASA of the tough fiscal environment in which the space station will have to be developed.

We determined that the management structure that's in place when we began our review simply would not work and unless a

major change was made the program would continue to be plagued by organizational problems. The lead center concept has been previously tried and used in NASA over the last 15 years or so with mixed results, and the Space Station Program was not getting the required management effectiveness from this approach.

We further concluded that the ultimate efficiency and economy in the design, development, test, and integration of the space station were central issues and that these could be significantly improved by putting all of the people, pieces, and organizations involved in a structure with clear and straightforward lines of responsibility and authority. Furthermore, in our minds, was to assure that we maintained clear contractor accountability as they ultimately will be responsible for the actual development of the space station hardware and software.

Our recommendations to Dr. Fletcher focused on two areas: first, on correcting the management structure; and, second, on improving the distribution of work among the field centers to maintain accountability and assure product quality.

To correct the management structure, we made four basic recommendations: first, to establish a Space Station Program Office at headquarters headed by a strong program director; provide technical support to that office through—by acquiring a contractor that's highly competent in system engineering and analysis and who could command the technical respect of field center personnel; establish a branch office in Houston for system integration; and provide line direction of the field center project managers directly from the Headquarters program management office.

Our recommendations on the distribution of work among the field centers was developed considering the fact that the definition phase of the program was already well under way. Eight contractors had been working on the study for 13 months prior to our committee's establishment, an extensive advanced development program was under way, and we had already invested substantial resources in this effort. We sought to accomplish our objectives without undoing the essential character of the technical work already under way.

Now the project responsibilities that were established at the beginning of phase B, which was launched in the fall of 1984, clearly represent a partitioning of responsibilities wherein the predominant role of the Marshall Space Flight Center was focused on the modules and the predominant role of the Johnson Space Center was focused on the configuration of the truss and its associated subsystems. The Goddard Space Flight Center was focused on platform design, servicing of free flying spacecraft, and the accommodation of attached payloads. The Lewis Center was tasked to study the development of the electrical power system.

Now on the basis of our extensive interviews with NASA project personnel and contractors, we concluded that efficiency, economy, and accountability argue persuasively for an approach which requires only one set of assembly fixtures, integration facilities, test equipment, and verification procedures, and does not involve the transportation of modules or other major system elements from one contractor or one factory to another.

As an example, the assignment of module's development to a second contractor would virtually guarantee that it would be different and hence more costly. Alternatively, the shipment of an unfinished or partially completed module to a second contractor for subsequent completion appeared to be inefficient, uneconomical, and would considerably compromise the accountability for the completed module. These considerations led us to adopt a principle of dividing work on the basis of subsystem components inside or outside the modules.

Consistent with this inside/outside principle, my committee advised Dr. Fletcher to proceed along the path that had been laid out in the directive that John Hodge had issued in the middle of May—May 13. We recommended that distributed subsystems—these are the guidance, control, thermal communications and so on—and module outfitting should follow the inside/outside partitioning that I've just mentioned.

However, we recognized that this might create a skill mix problem in NASA with regard to the habitation module. We acknowledged that the Marshall Space Flight Center has experience and demonstrated competence in the management of module development as a result of the highly successful Skylab and Spacelab Programs. Furthermore, were well knowledgeable that Johnson Space Center is the center of technical expertise and habitability and is responsible for the crew and that these two factors are obviously closely coupled.

We recommended that the habitation module be assigned in its entirety to the Marshall Space Flight Center but with technical direction by the Johnson Space Center for habitability, equipping, layout, and installation. This solution combines the Marshall management of the contract and the Johnson technical expertise without incurring additional cost to the program and simultaneously maintains contractor accountability.

I'd like to repeat what I said a moment or so earlier that from the beginning of the phase B work the work that has been assigned to the Marshall Space Flight Center has included the modules which include the habitability module, its structure, its environmental control life support system, and the basic equipping of that and the laboratory modules.

The work that I recommended shifting was the provisioning of that module with the habitability provisions, the equipping of that module internally with habitability provisions, and that that be accomplished under the Marshall contract with the technical direction of the Johnson Space Center. I think the nature of the recommendation has been misunderstood in prior discussions, and I'd like to try to clarify that point.

That concludes my comments. I'll be glad to answer questions but at the appropriate time, sir.

[The prepared statement of General Phillips follows:]

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PRESENTED BY WITNESS

Statement of

General Samuel Phillips

USAF, Retired

before the

Subcommittee on Space Science and Applications

Committee on Science and Technology

House of Representatives

August 5, 1986

Congressman Nelson and Members of the Subcommittee, I have been asked to speak to you today regarding my recent review of the management of the Space Station Program.

In April 1986, I was asked by Mr. John Hodge and subsequently by Dr. James Fletcher to review the organization and project responsibilities of the Space Station Program. My charter was to formulate recommendations by the end of June 1986. My specific objectives included a review of the management structure, the distribution of work between the field centers, any resulting changes to interfaces, and NASA's plan for in-house system engineering and integration. I was not asked to review the technical design of the Space Station and therefore my committee did not evaluate the current design.

Our process involved lengthy interviews at Headquarters, the Program Office at the Johnson Space Center and the five field centers involved in the Space Station Program. At each field center we visited the Center Director and the Project Office and then spoke independently with each of the phase B contractors. Once we returned to Washington, we met again with Mr. Philip Culbertson and Mr. John Hodge and we also spoke with Dr. Burton Edelson and his staff as well as with Admiral Richard Truly and members of his staff. On the basis of these numerous interviews and a careful review of relevant documents, we developed our conclusions and formulated our recommendations which we presented to Dr. Fletcher on June 26, 1986. An additional presentation was made to the participating Center Directors on June 27, 1986 with Dr. Fletcher present.

Prior to our review, there were several ground rules upon which the Phase B definition of the Space Station was based. The Johnson Space Center had been designated as the lead center which meant that the five field center Space Station Project Offices would report directly to the Program Office at the Johnson Space Center. In this arrangement, NASA would act as its own prime contractor and accomplish much of the system engineering and some of the system integration in-house. The number of centers involved and the use of in-house engineering expertise was chosen in order to take maximal advantage of available NASA talent and to technically strengthen those organizational elements involved in the Space Station Program. In addition, the Space Station Program was directed by the President to include international partners resulting in a greater degree of international participation than had been present in any earlier NASA program. The need to accommodate all of these ground rules resulted in an organizational structure of considerable complexity.

The Space Station Program has been a major NASA activity since 1982. Early configuration options developed by the Concept Development Group in 1982 and 1983 were further refined in the "Skunk Works" during 1984, culminating that autumn in the release of a request for proposal (RFP) for the definition and

preliminary design of the Space Station. In preparation for this release, work assignments were made to the NASA Centers and described in detail in the RFP. Because the Space Station configuration was still evolving at that time, and because the allocation of functions among the Space Station elements still required the conduct of several trade-off studies to determine their optimum distribution, several areas of overlap were contained within the work assignments. Furthermore, in 1985 and into 1986, as the definition phase studies performed by the contractors produced results, additional areas of overlap developed and needed resolution.

In May 1986, as my committee started to review the program's management structure, NASA was still in the process of sorting out the center roles and responsibilities for the detailed design and development phase of the program. A release of the requests for proposals to industry was planned for October 1986 and preparations for drafting these RFPs were beginning to get underway. On May 13, 1986, John Hodge, the then Acting Associate Administrator for the Space Station Program, issued a directive resolving much of the overlap among the field center work assignments. The directive anticipated that the remaining actions would be defined and implemented upon the completion of my committee's tasks.

The Space Station has a very complex infrastructure. It has many elements in Earth orbit and several elements on the ground to support launch preparations and check-out, to plan and support flight operations, and to receive and distribute data from investigations conducted aloft. The orbital elements consist of a manned base, several platforms co-orbiting with the base and also in polar orbit, and an orbital maneuvering vehicle. The manned base has a large number of elements. The pressurized modules include one for habitation and several laboratories. Also included are an unpressurized satellite servicing bay, several attachment points for the external mounting of scientific instruments, an extensive truss to provide the necessary external mounting areas, and the highest capacity electrical power generation system ever put in Earth orbit.

Throughout these elements are interwoven the subsystems necessary to run the Space Station and to provide services to its many users. These subsystems must not only accomplish a function from end-to-end, they must also assist each element in accomplishing its assigned function in the Program.

Because of its size and because it cannot all be produced and launched at once, the Space Station will need to be assembled and hence checked-out on orbit. It will be maintained on orbit through the continuous resupply of consumables and the exchange of experiments, and it will also be repaired on orbit. Due to its indefinite lifetime, the Station--both the manned base and the unmanned platforms, must be periodically modified to incorporate significant advances in technology and to provide improved and increasing user services.

The organizational participation in the program is extensive. Within NASA, five field centers are involved in a major way in the design and development efforts:

0 Goddard Space Flight Center;
0 Johnson Space Center;
0 Kennedy Space Center;
0 Lewis Research Center; and
0 Marshall Space Flight Center.

Three program offices will provide experiments:

0 Office of Aeronautics and Space Technology,
0 Office of Commercial Programs, and
0 Office of Space Science and Applications.

Two program offices will provide direct support:

0 Office of Space Flight, and
0 Office of Space Tracking and Data Systems.

The United States will be joined in the development, operation, and utilization of the Space Station by three international partners:

0 Canada;
0 The European Space Agency, representing 12 member countries; and
0 Japan.

All of these considerations contribute to the management challenge of the Program.

As my committee began its review, we found that two driving forces existed in the Program. The first, directed by the President in his State of the Union Address in January 1984, is to establish a permanently manned capability by 1994. The second is the strong realization within NASA of the tough fiscal environment in which the Space Station will have to be developed. We found that there was a need to assure that responsibility, accountability, and authority were clearly defined across the Program in order to create the ability to efficiently manage the development of all the elements which make up the Space Station.

We determined that the management structure in place when we began our review simply would not work and that unless a major change was made, the Program would continue to be plagued by organizational problems. The lead center concept had been previously tried in NASA over the past 15 or so years with mixed results and the Space Station Program was not getting the required management effectiveness from this approach. We further concluded that the ultimate efficiency and economy in the design, development, test, and integration of the Space Station were central issues and that these could be significantly improved by putting all of the people, pieces, and organizations involved in a structure with clear and straightforward lines of authority.

Foremost in our minds was to assure that we maintained clear contractor accountability, as they will be responsible for the actual development of the Space Station hardware and software.

Our recommendations to Dr. Fletcher focused on two areas; first, on correcting the management structure and second, on improving the distribution of work among the field centers to maintain accountability and better assure product quality. To correct the management structure, we made four basic recommendations:

- Establish a Space Station Program Management Office at Headquarters headed by a strong program director;
- Provide technical support to that office through the acquisition of a contractor highly competent in systems engineering and analysis and who would command the technical respect of field center personnel;
- Establish a branch office in Houston for system integration; and
- Provide line direction of the field center project managers directly from the Headquarters Program Management Office.

Our recommendation on the distribution of work among the field centers was developed considering the fact that the definition phase of the program was already well underway. Eight contractors had been working on the study for 13 months prior to our committee's establishment, an extensive advanced development program was underway, and we had already invested substantial resources in this effort. We sought to accomplish our objectives without undoing the essential character of the technical work already underway.

The project responsibilities established at the beginning of Phase B clearly represent a partitioning of responsibilities wherein the predominant role of the Marshall Space Flight Center was focused on modules and the predominent role of the Johnson Space Center was focused on the configuration, the truss, and its associated subsystems. The Goddard Space Flight Center was focused on platform designs, servicing of free-flying spacecraft, and on the accommodation of attached payloads. The Lewis Research Center was tasked to study the development of the electrical power system.

On the basis of our extensive interviews with NASA project personnel and contractors, we concluded that efficiency, economy, and accountability argue persuasively for an approach which requires only one set of assembly fixtures, integration facilities, test equipment, and verification procedures and does not involve the transportation of modules or other major system elements from one contractor to another. As an example, the assignment of a module's development to a second contractor would virtually guarantee that it would be different and hence more costly. Alternatively, the shipment of an unfinished module to a second contractor for subsequent completion appeared to be

inefficient, uneconomical, and would considerably compromise the accountability for the completed module. These considerations led us to adopt the principle of dividing work on the basis of subsystem components inside or outside the modules.

Consistent with this "inside/outside" principle, the committee advised Dr. Fletcher to proceed along the path laid out in the directive issued by Mr. John Hodge on May 13, 1986. We then addressed those remaining responsibility assignments not covered in the May 13 directive which included the power distribution subsystem, the outfitting of the habitation module, the communications subsystem, thermal subsystem, data management subsystem, guidance navigation and control subsystem, environmental control and life support subsystem, and the extravehicular activity subsystem.

We recommended that distributed subsystems and module outfitting should follow the "inside/outside" partitioning mentioned above. However, we recognized that this might create a skill mix problem in NASA with regard to the habitation module. We acknowledged that the Marshall Space Flight Center has experience and demonstrated competency in the management of module development as a result of the highly successful Skylab and Spacelab programs. Futhermore, we were aware that the Johnson Space Center has considerable technical expertise in habitability, is also responsible for the crew and that these two factors are closely coupled. Of the various possible solutions, we recommended that the habitation module be reassigned to the Marshall Space Flight Center but with technical direction of the Marshall contractor by the Johnson Space Center for habitability equipment layout and installation. This solution combines the Marshall management experience and the Johnson technical expertise without incurring additional cost to the Program and simultaneously maintains contractor accountability.

As a result of our extensive review of the management structure of the Space Station Program, I am convinced that our recommendation is the best approach for maintaining accountability, assuring product quality, and realizing cost-effectiveness in accomplishing the objectives of the Space Station Program.

This concludes my prepared statement and I would be happy to entertain any questions you might have.

Mr. NELSON. Thank you, General Phillips.
Mr. Stofan.

STATEMENT OF ANDREW STOFAN, ASSOCIATE ADMINISTRATOR FOR OFFICE OF SPACE STATION, NASA, WASHINGTON, DC

Mr. STOFAN. Thank you, Mr. Chairman and members of the subcommittee. I am pleased to be here today to discuss with you the review we have initiated at your request concerning the restructuring of the Space Station Program.

I, too, would like to enter into the record my full statement, and I'll go over and abbreviate it, a form of it, here in order to preserve time.

I have been asked by Dr. Fletcher to review his recent decisions, which were based upon the recommendations of General Phillips. We plan to retain the various management functions we now have. However, the program management function in SE&I—Systems Engineering and Integration—responsibility would be moved to the NASA headquarters. This will assure centralization of authority and identifiable accountability within the program.

The level A, which is my position, will consist of a small policy organization at NASA headquarters and a larger office in the Washington area with responsibility for program management and technical direction. The new Program Office will be headed by a Space Station Program Director who will report directly to me, and we've referred to that as the A and the A′ organization.

Current level B, systems engineering and integration, now at Johnson would become part of an enhanced part of the larger level A organization. This new program management and SE&I organization will employ several hundred civil servants and contractors, contractor personnel. Systems engineering and analysis would be performed locally while systems integration would remain at Johnson but would report to the program Director here in Washington.

Johnson personnel remain at JSC as part of the integration function or may join the new Program Office here in Washington. We are not currently establishing this Program Office, but its implementation must not be delayed unnecessarily as the program must move forward with this vital function in place.

Level C centers would largely retain their current responsibilities with some changes in the reporting structure. The level C program managers would report directly to the program Director here in Washington but would keep center directors informed, thus ensuring clear lines of accountability.

Proposed changes in work packages were to assign clear responsibilities and accountabilities for deliverable hardware and to eliminate overlaps and inefficiencies. We have formulated detailed responsibilities and implementation actions for the new structure which were reviewed and accepted by all levels of the program management. In parallel, we were incorporating changes in our RFP, the request for proposal, but at this time any and all implementation plans are pending the current review process.

Management of the level C work packages will continue at Johnson, Marshall, Goddard, and Lewis. Kennedy and Langley will continue to have important roles in consultation with the program.

Specific changes in work package responsibilities were planned. As Marshall has responsibility for overall lab and hab modules and has had before, module interconnects and air locks are to be transferred to Marshall. Contractual management of hab module outfitting would also be transferred to Marshall, but technical direction of the outfitting would remain with Johnson as that center is our center of excellence for manned space systems.

Also, I might point out that all of the research and technology, the development of the test beds, and all the fixtures would also all remain at Johnson throughout the program.

Johnson personnel would remain in Houston but would report to Marshall to provide technical management of the outfitting. Thus, we can ensure that one center and one contractor have ultimate responsibility and accountability for specific elements of the space station. Similarly, contractual management for station-keeping propulsion systems would be moved from Marshall to Johnson, with the same technical direction provided again.

Based upon the proposed changes, NASA Headquarters and Johnson have derived the following impacts to the centers, and the phase C/D contract funds would be distributed as follows. The approximate distribution without the proposed management changes—we'll do those first—Marshall, 32 percent; Johnson, 42 percent; Goddard, 10 percent; Lewis, 16 percent. The approximate distribution with the proposed management changes in place would be Marshall, 37 percent; Johnson, 36 percent; Goddard, 10 percent; and Lewis, 17 percent.

The above distributions are not exact. They will vary as the detailed implementation plans come along, but I'm sure they would be within a few percent.

For staffing impacts, civil service personnel will not change at any center. Contractor personnel at Johnson will increase by approximately 1,400, with another 1,300 contractor personnel to be distributed across the program as we implement the proposed changes.

I have been asked by Dr. Fletcher to review all aspects of the current baseline configuration. My review will encompass a number of recently expressed concerns, including EVA required for assembly and maintenance, STS launch capability when again operational, assembly sequence to achieve the baseline configuration, any impact in the utilization of the station, potential impact on our international partners, and overall technical performance and integrity of the station.

Concerning the program schedule, because of the intensity of review we are conducting, the RFP target date of October 15 will slip. In the interim, additional costs will be incurred by our space station contractors as they must keep their programs in place and their staff in place while awaiting the award of the design and development contracts.

In conclusion, I personally will keep the committee members and other interested Members of Congress fully informed as to all details of the review. Thus, we hope to ensure that the concerns of both Congress and NASA are addressed as we work together to go forward with the U.S. space station.

Mr. Chairman, I will be pleased to address any questions you have about the review that I am currently conducting on the proposed changes to the program.

[The prepared statement of Mr. Stofan follows:]

NASA
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Presented by Witness

August 5, 1986

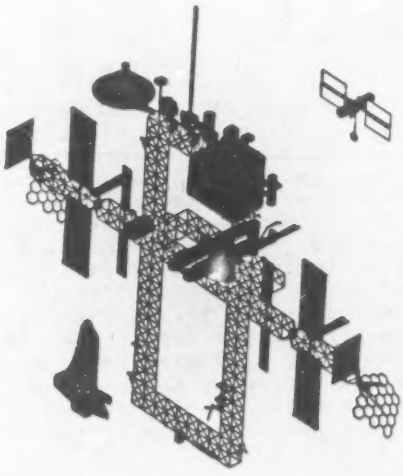
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

Statement by:

Andrew J. Stofan
Office of Space Station



99th Congress

Statement of
Andrew J. Stofan
Office of Space Station
National Aeronautics and Space Administration

before the
Subcommittee on Space Science and Applications
Committee on Science and Technology
U.S. House of Representatives

Mr. Chairman and Members of the Subcommittee:

I am pleased to appear before you this afternoon to discuss with you the review we have initiated at your request concerning the restructuring of the Space Station Program as announced by the Administrator on June 30. As the newly designated Associate Administrator for the Office of Space Station, I have been asked by Dr. Fletcher to review and evaluate his recent decisions on the Space Station Program management structure. These decisions were based upon the recommendations of General Samuel Phillips following his assessment of the program's management structure. I will discuss with you the specific steps which would be necessary to implement these decisions, the impacts on individual center and contractor roles, the cost of these decisions as currently estimated, and the effects on the current program schedule.

As we currently view the proposed changes to the program, the various management functions would be retained as currently structured. However, increased management authority in the form of the system engineering, analysis, and integration (SE&I) function for the program would be transferred to NASA Headquarters. In this manner, along with the proposed changes in the work package structure, we believe that centralization of authority and identifiable accountability can be realized.

Specifically, the Level A program management organization will consist of a relatively small organization located at NASA Headquarters with responsibility for policy and overall program direction and a larger office located in the metropolitan Washington area with responsibility for program management and technical direction. The Level B management and SE&I function now located at the Johnson Space Center (JSC) would become enhanced as part of the new larger Level A organization in Washington. It will be headed by a Space Station Program Director who would be responsible for the overall technical management of the Space Station Program and who would report directly to me as the Associate Administrator for Space Station. Within the

Level A organization, the program management and SE&I organization will be of prime importance to the program as its responsibilities will include providing overall technical direction and functioning as the primary integrator of systems into and across all elements of the Space Station thus ensuring that the entire system meets all technical and functional requirements.

The program management and SE&I organization would be composed of several hundred civil servants and support service contractor employees located in the metropolitan Washington area. Systems engineering and analysis would be performed locally while the systems integration portion of the SE&I function would remain at the Johnson Space Center, but would report to the NASA Headquarters SE&I organization. Personnel now located at the Johnson Space Center Level B organization will be able to remain there as part of the systems integration function or will have the opportunity to join the new program office as it becomes established. We are not currently implementing the establishment of the local program management office or relocation of the SE&I organization, but it must be recognized that it is important that it not be delayed unnecessarily as the program must move forward with this vital function in place.

The Level C NASA field centers which are currently responsible for managing the four technical work packages would largely retain those responsibilities with some changes in the reporting structure. The Level C program managers would report directly to the Space Station Program Director, but would continue to work closely with their respective center director to keep the center fully informed of program activities and to have access to and to utilize center resources most effectively and efficiently. The proposed changes in the work package responsibilities were designed to assign clear responsibilities and accountability for deliverable hardware for launch and assembly and to eliminate the overlaps and inefficiencies inherent in the former work package structure. Based upon these proposed changes, we had formulated a detailed set of defined responsibilities and implementation actions. These were reviewed and accepted by each level of Space Station Program management down to and including the Level C management teams. The proposed Level C work package changes have been discussed with the current industry contractors, but no contractual changes have been directed. In parallel with the proposed changes we were also incorporating necessary changes into the request for proposal (RFP) for the design and development phase so as to be consistent with the proposed work package changes. At this time, any and all implementation plans are pending the current review process which we have undertaken at the Committee's request.

The management of the Level C work packages will continue at the Johnson, Marshall, Goddard, and Lewis field centers. Kennedy Space Center and the Langley Research Center will also continue to play important roles in the program. As noted previously, to insure clear accountability for the delivery of Space Station

elements which will include the structure, the modules, the power system, and platforms, we had planned modifications to some of the responsibilities within the four work packages. Most notably, as the Marshall Space Flight Center (MSFC) and its prime contractors currently have responsibility for the overall laboratory and habitation modules, it was recommended by General Phillips that responsibility for the module interconnects and airlocks be transferred to that work package. Similarly, as the habitat module outfitting will ultimately become part of the habitation module which will be developed through MSFC and its contractor, the contractual management responsibility for that outfitting would be transferred to MSFC. However, very importantly, the technical direction for the development of the outfitting, that is, the manned systems portion of the habitation module, would remain at the Johnson Space Center, NASA's acknowledged center of excellence for manned systems. Programmatically, personnel at JSC who have technical responsibility for such outfitting of the habitation module would report to the Level C program manager at MSFC who would contractually manage a single contractor to build and deliver the habitation module. These personnel would, however, continue to work at JSC in Houston. In this manner we can insure that one center and one contractor have ultimate responsibility and accountability for that portion of the Space Station. Similarly, contractual management for the station-keeping propulsion system would be moved from the Marshall Space Flight Center to the Johnson Space Center.

Based upon the proposed management changes, the Office of Space Station and the Space Station Program Office at JSC have derived the following assessments of cost and personnel impacts on the various field centers. The estimated design and development phase prime hardware contract funds would be distributed among the Level C centers approximately as shown below:

Approximate distribution without the proposed management changes:

MSFC	JSC	GSFC	LeRC	Total
32%	42%	10%	16%	100%

Approximate distribution with the proposed management changes:

MSFC	JSC	GSFC	LeRC	Total
37%	36%	10%	17%	100%

These distributions are not exact, but will be within a few percent of those actually implemented. The proposed changes would probably vary slightly during the implementing process.

In regard to staffing impacts, the civil service personnel levels at the Marshall, Goddard, and Lewis Level C field centers would experience no increases or decreases due to the proposed management changes. There would also be no changes in the Johnson Space Center civil servant personnel level. Specifically, the total overall personnel level at JSC for all programs is now approximately 12,600. With the proposed changes to the Space Station management structure, that average level over the next seven years is estimated to increase to about 14,000 due to a projected increase in the level of Space Station support service contractor personnel at JSC. An estimated additional 1300 support service contractor personnel will be distributed across the centers and at the relocated Space Station Program Office, the actual distribution of which will depend upon the actual implementation of the proposed management changes.

I have also been asked by Dr. Fletcher to review all aspects of the current Space Station baseline configuration. This review will encompass recently expressed concerns such as the amount of extra-vehicular activity required for assembly and maintenance of the Station (a concern raised by the astronauts), launch capacity of our Shuttle fleet when again operational, assembly sequence of the baseline configuration, program costs and schedule, any resultant impact to the utilization of the Station, potential impact on our international partners, and the overall technical performance and integrity of the Station.

Based upon the proposed management changes and the design modifications which are being considered, we had originally anticipated that there would be no or little impact to the program schedule and had continued to plan for release of the RFP in October. Now however, because of the intensive review we are conducting, it is probable the RFP target release date will slip. In the interim, additional costs will be incurred by our Space Station contractors as they must keep their programs in place while awaiting the award of the design and development contracts and the commencement of those contracts which were planned for May of 1987.

While the review as outlined above is being conducted, the Office of Space Station, and I personally, will keep the Committee Members and other interested Members of Congress fully informed as to all details of the review. Thus we hope to ensure that the concerns of both the Congress and NASA are addressed as we work together to go forward with the U.S. Space Station.

Mr. Chairman, I would be pleased to answer any questions you may have concerning the review of the proposed changes to the Space Station Program.

Mr. NELSON. OK. Thank you, Mr. Stofan. Welcome to Washington.

Mr. STOFAN. Thank you.

Mr. NELSON. Mr. Aaron, did you have a statement?

STATEMENT OF JOHN AARON, ACTING MANAGER, SPACE STATION PROGRAM OFFICE, LYNDON B. JOHNSON SPACE CENTER

Mr. AARON. No, I was not asked to prepare a written statement. However, I am available for questioning, if I can be assistance on relative details of the program.

Mr. NELSON. OK.

All right. Now here is how we're going to proceed for the members of the committee. After Mr. Walker and I have asked one or two questions, I'm going to go in order of seniority first for the members of the committee and then for anyone who has chosen to join us, and all are welcome. So that's the procedure upon which we will do the questioning. We're not going to put any time limit on you.

OK. I want to kick this off by getting right to the question of what is going to be the effect of these changes upon the contractors, realizing that the space station, in large part, is going to be successful because of the ability of NASA giving leadership and direction to the contractors and them going on and proceeding on the basis of the design of the hardware.

In the most recent issue of Av Week, there is a statement that concerned me, and we have picked up these vibrations. It says, "Station contractors affiliated with Marshall have started to call station contractors affiliated with Houston seeking help with new unexpected responsibilities," and then it goes on to put its editorial comment in what otherwise would be a news article, "another indication of confusion in the project."

All right. Now with that as a background let me ask you, Dr. Fletcher and Mr. Stofan, how closely has NASA kept in contact with the contractors on this matter and on the changes? Which one of you would like to address that? Go ahead, Dr. Fletcher.

Dr. FLETCHER. I think I would like to start. In my own case, I have stayed away from most of the contractors on purpose since RFP's were pending, and generally it's the practice of not discussing proposed contracts with contractors, and I will probably end up being the source selection official. That doesn't mean that's a firm and fast rule, but so far we haven't—I haven't personally been involved in discussions of work packages with potential contractors. That may not be true of Mr. Stofan.

Mr. STOFAN. Yes. I have personally talked with every one of the contractors, and there was initial confusion on their part. However, in a very short period of time that confusion began to go away as we began to define in more detail what it was exactly we were implementing, and the first step was the general implementation of the recommendations.

The next step was to take that to a much lower level of detail, prepare a detailed statement to be sent to the centers and then to the contractors, so that there would be no confusion in the process at all. What has happened here has happened right in the middle

of the process. We have that more detailed implementation plan, and we're ready to send it out the beginning of the week, but since we've decided to take another look, we have not done that, so we couldn't take the next step to clarify the position.

Mr. NELSON. Now this next step that you're talking about is getting them sufficiently directed so that they know how to respond to an RFP?

Mr. STOFAN. That's correct, and we had to stop that process when we said we'd stop and take a look, so they have not been given that next level of detail of direction which we intended to give them, and they need that to go ahead and prepare the RFP's.

Mr. NELSON. And you're looking at the RFP, you said, some time after October 15?

Mr. STOFAN. Yes. We originally had intended to release the RFP for comment to the contractors August 15 and then by the middle of October have the final RFP released. So that process is in abeyance right now per the instructions we had from Congress.

Mr. NELSON. Well, now, do all these guys have to hang in limbo for—let's see, August, September, October—another 3 months?

Dr. FLETCHER. Mr. Chairman, we haven't laid out a program which accommodates that up to 90-day period. We are in the process of doing that. So to give you precise dates on how much the work package is going to slip and so forth would be premature at this time.

On the other hand, we'd be glad to supply that within the next 30 days and give you some idea of where we stand on these things, in connection with your desire and properly so, to keep track of where we're going on this thing. But we really aren't that far along to be able to say in exact weeks, months, and so forth, where our program stands.

[The information follows:]

We sent out the draft Requests for Proposal (RFP's) for comment by Industry on November 26, 1986, and plan to issue the final RFP's after the first of the year 1987.

Mr. NELSON. Well, I understand that.

I want to understand for purposes of this hearing if there is unneeded confusion because of lack of direction and changing of policy among the contractors that would be harmful to the overall moving ahead of the space station. That's what I'm trying to get at.

Now how are they going to be able to respond and put together these technical teams necessary?

Mr. STOFAN. We are starting the process, the review that Dr. Fletcher has asked me to do, and we started that process yesterday with the people from the centers, the C work package managers were all here in Washington. We spent a day with them going into detail of how we would conduct the review. They will also—I asked them at that time to go back to their contractors and involve their contractors in this review process that we've been asked to carry forward. So they will be involved some time this week.

Mr. NELSON. Well, what about the fact that some of them may have to reteam with others in responding to this? What do you think about that, Mr. Stofan?

Mr. STOFAN. Some of them may have to reteam, that is correct.

Mr. NELSON. All right. Now it certainly is the concern of this committee that if right here at the last minute they have to reteam, here you're looking at an RFP coming out some time this fall, they're going to have to reteam and get ready for it within a matter of 2 months, of which they've been building up their teams over the course of the last 2 years. How do you respond to that?

Dr. FLETCHER. Let me try that first, Mr. Chairman.

There's no question but what this 90-day stand-down is going to cause some confusion and rearrangement among the contractors. On the other hand, that has to be balanced by your concerns in this committee and others in Congress from the Texas delegation, and I felt there ought to be a cooling off period even though it does cause some extra concerns and possible rearrangements of contractors.

So you have to balance the consequences of not standing down for 90 days versus the possible, as you say, confusion among contractors.

Mr. NELSON. How long, for example, for the record, if you will give it to us, does it take a prime contractor to negotiate and come to agreements with subs?

Mr. STOFAN. We will have to supply that for the record.

Mr. NELSON. Well, approximately.

Dr. FLETCHER. It probably varies. I've been involved in quite a few of these things, and General Phillips has, too, as a private contractor, but once you have a very clear picture of what the work package consists of the RFP, for example—it does take a month or two, something in that vicinity, to renegotiate with the appropriate subcontractors. Now that's been my experience. General Phillips has had similar experience and I think maybe a lot more than I have.

Do you want to try it?

General PHILLIPS. Well, I think teaming agreements can be made or changed, depending on the evolution of a major program, rather quickly. It depends on the business interests of the contractors that are discussing the teaming arrangement. But I think teaming arrangements can be—and agreements that are teaming and prime and sub relationships in a major program can be worked out in a matter of days and consummated in a matter of days when circumstances indicate agreement to proceed in a certain way.

Mr. NELSON. Well, let me ask this. Do you think that there's expertise in the primes that cannot be transferred when you have to reteam?

General PHILLIPS. No.

Mr. NELSON. Do you think that is, no matter which way they split up their responsibilities, according to your changed arrangement, you think that they can be transferred within the short period of time that we're talking about?

General PHILLIPS. Well, I think the answer to that is yes, that the industrial concerns—the industrial companies that are involved can revise teaming agreements to meet the needs of their business interests and the changing program.

I'd like to add a comment, though, that I think is relevant to this point, that the requirement that would be given to contractors for the phase C/D development work, the request for proposal that had

been planned to be released in October, it's been clear now for quite some time that NASA needed to make the final decisions on the assignment of work in order that that request for proposal could be issued, and there's a discussion here of changing the assignment of work. The principal change that's involved here is the contractual responsibility for equipping—the habitability equipping of the habitability module; I think that's a principal change that's involved.

I guess the point I'm trying to make is that it's been clear now for months that final determination is needed to be made in this current period to assign the work for the phase C/D request for proposal.

Mr. NELSON. OK. The context in which this hearing is taking place is that no one had ever alerted anyone to any major changes in the teaming arrangements, in the distribution of the work, and therefore some of the confusion has arisen. We thought always along that as we projected on the contracting out and the building of the space station that it was going to be clean-up little acts along the way, not major changes.

Dr. Fletcher.

Dr. FLETCHER. Mr. Chairman, I think it's important at this point to clear up two kinds of changes, and we ought to be careful which one we're addressing. The one change was the small change in the work package, or at least small from our point of view, that we suggested on June 30 as a result of General Phillips' review, and that's what General Phillips was addressing. That kind of a change would be a relatively small change in the RFP, and the realignment of subcontractors could be done very quickly.

What I was referring to was the second change which may or may not occur, and I think Mr. Stofan was referring to that, too, as a result of this 90-day standdown. That may be a much more dramatic change, and I think that's at the present time where most of the confusion is.

Mr. NELSON. And then of course there's another change looming over this whole thing, which is not the subject of this hearing, and that is the question of redesign, which has had some notoriety of late.

Dr. FLETCHER. That also, Mr. Chairman.

Mr. NELSON. Well, let me ask you this, Mr. Aaron. Do you know of any uncertainties that have affected the contractors, with regard to making corporate investments and commitments over the fact of what they were planning over several months, and having that changed as a result of this announced intention of NASA?

Mr. AARON. Chairman Nelson, I don't have a direct insight on those corporate decisions; and I no doubt suspect that there are some. However, I don't have insight into that in terms of direct knowledge relative to this specific decision.

Mr. ANDREWS. Would the gentleman yield for just one point?

Mr. NELSON. I will yield, with trepidation, because if I yield to you, have got to yield to somebody else.

Mr. ANDREWS. Just for one point that Mr. Aaron might want to comment on.

The Clear Lake Economic Development Foundation, which is in the Johnson Space Center area, is in the process of trying to come

up with the answer to this very question, and their estimates, as of today, is that the private investments in the area, by the private sector in industrial equipment and hardware that has been purchased by aerospace companies for work on the station before the change, is $12 million; real estate infrastructure expenses, $10 million; and commercial and industrial facilities, about $170 million has already spent in anticipation of the plan before the announced change.

This estimate is not complete, and the study is ongoing. But just for the chairman's benefit—and Mr. Aaron you might want to comment—does that statistic, do those three numbers sound unrealistic to you, of what you, in your best judgment, would be a number of investments already made?

Mr. AARON. Well, again, I am aware of the general thrust of that particular industrial effort building up in that area. I don't have direct knowledge as such that I can comment on the accuracy of those facts. Although, those should, certainly, be within the realm of reason.

Mr. ANDREWS. I am sorry, your answer was?

Mr. AARON. Although I don't have direct knowledge and capability to judge those particular facts, although they do seem in the realm of reason.

Mr. ANDREWS. Thank you, Mr. Chairman.

Mr. NELSON. Would any of the rest of you like to comment on that question of ours, of the uncertainties of the contracts with regard to making corporate investment?

Dr. FLETCHER. Mr. Chairman, I think we have covered that. But I think it is also important to talk about the two changes. When we talk about a change, we ought to make sure we are addressing the same change.

The first change is the small one that General Phillips talked about. The second change is the 90-day standdown, and we don't really know very much what changes that will involve at this time.

Mr. NELSON. All right.

I will call on our colleague here.

Let me just make sure that this committee is concerned about any work package shifts that would result in contractor teams teaming up that would not be suited to the new work, in part, brought on by virtue of it being sprung on them here at the last minute; and we are looking at the long term here.

Dr. FLETCHER. Mr. Chairman, we are not going to spring it on you again. I think you have got our attention at this point. We are not planning to spring anything on this particular committee, but also the rest of the committee's in Congress, again.

Mr. NELSON. OK, we will look forward to that assessment.

Mr. Walker.

Mr. WALKER. Thank you, Mr. Chairman.

The Appropriations Committee has already passed language indicating that for the next fiscal year you would be unable to reassign programs or transfer personnel from JSC without the express authorization of the Congress; what effect will that have on the plans that you are trying to implement, if that becomes the law?

Dr. FLETCHER. Well, it is hard to say, because that is a one sentence, Mr. Walker, description. I would hope that would not apply

to, for example, the transfer from one individual, from one of the centers to Washington, for example.

I would hope that would be interpreted as a broad shift in personnel or responsibilities from one part of NASA to another. If that amendment were enacted into law, of course, we would have to come back and tell you what we propose to do, and get your approval to go ahead.

Mr. WALKER. I guess my concern is if, for example, that were enacted, would that prevent you from going forward with the transfer of the work packages?

Dr. FLETCHER. I would certainly think that it would prevent us from going ahead and changing the work packages one way or another. In other words, it would be frozen, sort of in limbo, where we now are.

Mr. WALKER. It would also prevent you from doing the management reorganization with a centralized headquarters in Washington?

Dr. FLETCHER. Well, I hope it wouldn't do that, Mr. Walker. We don't plan to make large shifts. But small shifts in personnel, if we want to get on with this program, are going to be required.

We are not talking about shifts of hundreds of people. But shifts of tens of people. So, that we can actually begin to get control of the situation, so to speak.

It is quite clear that because of some of the confusion that has been going on about numbers that you get different answers from different parts of NASA on some of these questions. We hope that doesn't continue. In order to prevent it from continuing, we have to get control of the centers.

Mr. Stofan may want to comment further.

But some small changes I would hope could be made without having to come back here. But we would appreciate your guidance on this subject.

Mr. WALKER. Well, I guess part of my concern is, though, a moment ago you indicated that you thought that the recommendation of General Phillips was a fairly small item in all of this. I think that most people here on this committee regard that recommendation as not being a fairly small item but being a rather large item, and that some of our concern comes from that. So, I mean, if you are talking about a small transfer as being something of the magnitude of the Phillips' proposal, then, I think we would have some concerns.

If what you are telling me is that you would be concerned about tying your hands in such a way that you couldn't transfer someone out of Johnson to Washington, as a part of reorganizing management in Washington; I have got that concern, too. That is one reason why as I look at that language it strikes me as being somewhat over reactive, because I think it could give us real problems in managing the agency if that language were to be held as meaning that no one could be transferred at any point for any reason.

Mr. NELSON. Would the gentleman yield?

Dr. FLETCHER. Mr. Walker, I would like to clarify something that I may have said, or may have misspoken, I don't know which. When I was referring about a small change, I was talking about a small change in the work packages, in regard to the previous ques-

tion about subcontracts and realignment of subcontractors. That was a relatively small change in a work package.

It would be considered and it, obviously, is a big change in the shift of personnel, and would be regarded so by this committee. So, I want to be sure you understand what I was saying in the context of which——

Mr. WALKER. Let me yield to the chairman for a moment; and then I want to come back to that point.

Mr. NELSON. I thank the gentleman for yielding.

On this point, I, along with our colleague, Chairman Eddie Boland of the Appropriations Subcommittee, did not feel this language was in the best interest, because as the gentleman from Pennsylvania has stated, it is an attempt at micromanaging, and it was also an attempt at legislating on an appropriations bill, which under the rules is not permitted.

Mr. WALKER. But not unusual.

Mr. NELSON. Not unusual.

But nevertheless, I want to inject here that the language, if it were to become law, which is doubtful, but if it were to become law, contrary to your statement Dr. Fletcher, it certainly would not cause you to stop the Space Station Program, for the language says: "Provided that none of the funds in this bill shall be used to reassign programs and/or transfer personnel for the Johnson Space Center without the express authorization of Congress."

Dr. FLETCHER. Yes; I am not sure how that would work, and understand Mr. Walker's concern. I hope—and I would appreciate guidance from this committee—I hope that wouldn't mean that we couldn't transfer, as I said, 10 people from one center to another so that we could get on with the job. But I would appreciate your guidance on the subject.

Mr. WALKER. Well, let me follow up now on the point we were making just a moment ago. I guess that some of us have a concern that the transfer of what appears to be habitability work from Johnson to Marshall is, in fact, what you are describing, and maybe I misunderstand what you are describing, as being a fairly small change.

Dr. FLETCHER. No, it was the work package change that I was describing. The work package is the contractor's responsibility, and I don't want to say small, but it could be accommodated by adjustment of the subcontracts of the prime contractor, whoever wins. It is small compared to the total size of the contract, maybe that is a better way to have said it.

The transfer of people from Houston to Huntsville, apparently is a very big change, and I wouldn't want to make that change without coming back to the Congress.

Mr. WALKER. The transfer of the people is involved with the substantive management change of assigning a new responsibility to Marshall?

Dr. FLETCHER. I think it is primarily assigning a new responsibility to headquarters, Mr. Walker, that is where people change would come in, if any.

Mr. WALKER. Well, some of us—there is an aura of confusion here, at least on my part, and I think on the part of many others, that, if, in fact, what you are talking about is a transfer to head-

quarters, I see that largely in line with what the Rogers Commission recommended. I think that you have brought someone in to look at the Roger Commission recommendations of eminent qualifications, in bringing in General Phillips.

What I am a little puzzled by then is once you transfer that management structure up to headquarters, why, as a part of that, we are also beginning then the reassignment among the centers before that new headquarters unit ever really begins the management of the program?

Dr. FLETCHER. I am going to ask Mr. Stofan to comment on that in a minute.

But we have never said, to the best of my knowledge, we, at Headquarters, who are supposed to be managing this program, have never said we are transferring people from Houston to Huntsville. That was never said by anybody that I know of, at least on my staff. I doubt that it was said anywhere else.

We only talked about a change in the work package, and that was simply a reduction, or seemed to be a reduction in the prospective jobs at Houston. I don't believe we had ever estimated an increase in jobs at Huntsville as a result of that work package change.

Mr. Stofan may want to correct me on that.

Mr. STOFAN. No, that is correct. The transfer of people were here to the Washington area, to bring the management functions into Washington——

Mr. WALKER. How many people?

Mr. STOFAN. And the second thing was there are two parts of the recommendation we are implementing.

Mr. WALKER. Let me interrupt.

How many people are you talking about transferring?

Mr. STOFAN. We are planning to have that office staffed with a couple hundred civil servants, and several hundred support service contractors. The civil servants will come from NASA headquarters and from all of the centers.

Mr. WALKER. Well, when you are talking about transferring people from JSC, how many people are we talking about transferring out of JSC, bringing them to the Washington for the headquarters, then?

Mr. STOFAN. That depends on how many are willing to come. We are going to recruit, to staff the SE&I office in Washington with civil servants; we are going to recruit at every single one of the centers to staff that office.

So, to say the exact number that are coming, I do not know what that exact number will end up being until we do it.

Dr. FLETCHER. It will certainly be less than the 200, only a fraction of that 200 will come from Johnson.

Mr. WALKER. OK. The bottom line is that the concerns that you hear coming out of Texas and/or out of Huntsville, are largely concerned with the growth that they expect in jobs in the future as the Space Station Program expands, rather than a concern about the particular transfers of positions that are presently in place?

Dr. FLETCHER. That is correct, Mr. Walker. Most of those are not civil servants, those are contractors that may or may not appear or disappear as a result of these work package changes.

Mr. WALKER. I think that is all the questions I have at the moment, Mr. Chairman.

Mr. NELSON. OK.

Dr. Fletcher, you might want to clarify. We heard that there was a statement made earlier by you today that if the President did not come out and recommend, and the Congress dispose of providing for a replacement orbiter, that you are reported to have said that it would kill or significantly reduce the space station?

Dr. FLETCHER. Mr. Chairman, that has to be restated in the context of the question.

Mr. NELSON. Please, state it.

Dr. FLETCHER. I was asked whether or not I, personally, thought that you could assemble the space station with three orbiters. And I indicated that there is considerable discussion on that subject within NASA and disagreement.

I had thought previously that if we really were sure that those three orbiters would work and we would not have any downtime on those three orbiters, that we probably could extend the period of constructing the space station over more than a 2-year period, and try to at least do it with three orbiters, supported by whatever expendables we had to use. It is my personal opinion that that first earlier thought is in question at this point. I am not sure that we can assemble the space station if, indeed, for now and the foreseeable future, we only have three orbiters.

Mr. NELSON. Well, certainly, from our experience thus far, where even with four, for one reason or another we had considerable delays; for one reason and another we had considerable cannibalization of parts; for one reason or another with the demands, even on a relatively benign schedule as compared to the schedule of the mid-1990's, we had delays and shifting of payloads, and so forth.

Inevitably, in the future there are going to be delays. So, just crank that in to your calculations on whether or not you can do it with three, and remember that what we are planning on has to take us all the way into the next century, as far as a manned vehicle for access to space.

Mr. FLETCHER. Mr. Chairman, as you know, you don't have to persuade me that four orbiters is kind of a minimum number for a fleet. I have always felt that five was the right number, and I still do. But this is not the time to be asking for a fifth.

Mr. WALKER. Mr. Chairman?

Mr. NELSON. I understand it, but this an opportunity to air an issue among some of our colleagues who have joined us today for other reasons, and I didn't want to miss that opportunity.

Mr. WALKER. Mr. Chairman?

Mr. NELSON. Mr. Walker.

Mr. WALKER. Just a followup on that, just for a moment.

The thing that concerns this gentleman is that I understand, also, though, as a result of that, we are now looking at some redesigns for space station. I am not wholly unopposed to the idea of looking at some redesigns.

I think Senator Matsunaga may have come up with a idea that we ought to look at in terms of creating an infrastructure kind of concept that would use more limited shuttle capacity.

But I am concerned about some of this talk now about going back to an Apollo type of vehicle that would be attached to the space station, that would therefore provide an escape route, and parachute back, and so on. You know, some of the things I have read recently that people are now talking about in all of this, strike me as being headed backwards. I hate to think that that is where we are going.

Dr. FLETCHER. Mr. Walker, they concern me, too. I have been reading the literature and listening to Congress, and there are at least three versions of the space station that I know about from Congress, and at least three others that I read about in the various journals.

We really can't design a space station based on what we read in the newspapers. You have got to give us a little bit of leeway to get focused on the problem and design a space station which will be right for the Nation.

That that is what Mr. Stofan is going to do in less than, hopefully, less than 90 days.

Mr. NELSON. OK; by order of seniority, for the members of the committee, it will go like this, Mr. Barton, and then Mr. Chapman; and then by order of seniority on the nonmembers of the committee, it will be Mr. Andrews and Mr. Delay.

All right, let's proceed, Mr. Barton.

Mr. BARTON. Thank you, Mr. Chairman.

I am very glad that you distinguished gentlemen are here today.

General Phillips is the former program manager of the Apollo Program. You have certainly got a tremendous track record.

Dr. Fletcher, in your previous directorship of the overall NASA Program, you have got a good track record.

I am a brand new Member of Congress. I have been here about 1½ years.

Before that I worked out in the private sector for an oil and gas company, for a business forms company, and I never had to make the kind of decisions that you gentlemen have to make. But I have gone back and I have reviewed the decisions that you tentatively propose with regards to the space station.

I see that on April 11, General Phillips had an initial meeting with John Hodge, who was here in the room. On May 27, he went down to Houston and talked to the people down there for 4 days. On June 17, he talked to the people over at Marshall for 2 days. He ended up in Washington in late June, and talked to you again, Dr. Fletcher. So, a fairly substantial amount of review has gone into this.

I have yet to see in anything that you, Dr. Fletcher, presented, and in General Phillips testimony, and Mr. Stofan's prepared testimony, I don't see one thing that talks about the cost, that gives us a dollar figure. Now, the only figure that I have seen that relates to cost is a memo that the Johnson Space Center people prepared back in July, that has been disavowed, and it says that the one-time cost for this transfer is $281 million.

Now, until you show me otherwise, I am going to assume that these proposals, if they become fact, are going to cost $281 million. So, I am going to ask you one question. I asked it to you in a letter last week. I have talked to the chairman about it.

I want you gentlemen, who have tremendous track records of management, and you have reviewed this, tell me and this committee, what your proposals are going to cost in one-time fixed costs, transfers, and in long-term operating costs?

If you can satisfy this committee that it saves money, I don't think you are going to have a problem.

Dr. FLETCHER. Mr. Barton, I think Mr. Stofan will answer that.

But I think you are being a little unfair with us at this time. We really haven't completed phase B, and you are asking us already about cost.

We will do the best we can to answer your question, but you must regard them just as you must regard baseline jobs that we gave you—what was it, week before last; week before last—as our best estimate as of that time. We don't have conclusive estimates of costs or jobs, and we won't have until, actually, not even at the end of phase B, but after we get the proposals in from the contractors.

Having said that, Andy, do the best you can.

Mr. STOFAN. OK, I will answer part of it and then would like General Phillips to step in on some of the implications of the decisions on long-term costs.

The specific $281 million, if it is the same numbers that I have seen, that were reported out of Johnson before, were based upon a set of assumptions after the decisions were made. That set of assumptions would result in the $281 million impact.

After the time that estimate was made, we had a meeting in Washington with all the center Directors and the program Directors, we went over the assumptions that they had made, and the assumptions were, "worst case." It turns out those assumptions were not properly interpreted; and when they were properly interpreted the $281 million went to zero.

The people involved in making up the original numbers, the $281 million, said, if that is what you mean, and that is the interpretation we are to follow—and this was all the people, the Johnson people and everyone else—said no, that $281 million would go to zero. It had to do with the commonality of hardware.

They assumed that when the decision was made that there was a deliverable end item, the modules, that there would be no common hardware, that is that the end-to-end systems that were being developed would stop at the edge of a module, and we wouldn't have commonality of hardware from one thing to another. That was a wrong interpretation.

The interpretation that I gave them, we were going to have as much commonality now as we had before. Commonality is very, very important. Because what they did is assume dual development, on identical hardware because of the way the work packages were structured. That was not the intent at all.

When we straightened that out, they said, yes, they agreed the $281 million, went to zero.

Mr. BARTON. Well, I would like to take issue with that, if I could. Every decision that I have been given when I was a plant manager or assistant to the vice president, that involved a restructuring or a transfer, as some point in the process, the cost number came up; what is it going to cost.

Now, General Phillips, you have got a record as program manager of Apollo that is second to none. You were asked by Dr. Fletcher to make this study, an overview, and you spent a fair amount of time at it.

In making your recommendations to Dr. Fletcher, and the other senior management at NASA, did you just assume that the cost was irrelevant; are there some cost numbers that you have that you haven't shown the committee; or as Dr. Fletcher said, that is going be something that is done later?

Dr. FLETCHER. Before General Phillips answers, I think you ought to be clear about his background. He has had extensive program management in Government, but for the past, it must be, 17 or 18 years, he has been private and, in fact, in the energy business, which you have described; so he has plenty of experience in both sides of the aisle.

I wanted to make sure that was on the record, in case you had forgotten.

Mr. BARTON. Thank you, Doctor.

General PHILLIPS. Well, to respond to your question, cost is very relevant. And the cost of this program in its totality and to the Nation, I think, is a very important issue.

I did not, in the course of my review, conduct a detailed cost study. The two issues, the major issues on which cost judgments, I think, are relevant, is the restructuring of the management organization to establish a strong program office in Washington, and the organization that flows from that. With that organization support by a competent technical support contractor here in Washington.

My own view is that the cost of that program structure may involve some transitory initial cost to get it going.

But in the long run it is going to save the program money because of a responsible, well-structured, clear organization of responsibility and authority. So, my own judgment is that will be a positive and an efficiency improvement and, therefore, in the long run will save the program money.

The other major recommendation had to do with the assignment of responsibility for habitability equipping of the habitation module. The approach that I recommended will have one common set of modules that will be built after having been developed in one factory, and delivered as a completed end item. I think that will be a significantly less costly approach than an alternative which would be to move a partially completed module to a different factory and to complete its equipping and delivery or another alternative that we have certainly considered, which would be to develop an entirely different module under a different contractor and deliver it, which, I think, would be more costly.

So, it became a matter of judgment of relative values, and in my judgment the approach recommended will be a less costly approach for——

Mr. BARTON. But you don't have any numbers to back that up; that is purely a judgment call on your part?

General PHILLIPS. That is exactly what it was and how I described it.

Mr. BARTON. Well, in my opinion, as one member of the committee, I don't think you make multihundred million dollar judgment

calls on cost, and then ask the committee to take those judgment calls at face value. I would hope that you gentlemen respond by doing a cost analysis and present it to this committee for further consideration before any of these proposed changes go any further.

I think that is just good common sense to do that. If I were in your shoes, I would certainly do so. I think it is a wise thing to do.

[The information follows:]

Space Station personnel presented a special status briefing to the staff of the House Subcommittee on Space Science and Applications on October 30, 1986, which provided information supplementary to that supplied in NASA's October 3, 1986, report on work package options. This supplementary information was forwarded formally to the Subcommittee by letter dated November 26, 1986, from Administrator James C. Fletcher.

Mr. BARTON. Mr. Chairman, I have about four pages of questions; but I am going to defer until everybody else has a chance to at least ask one round of questions.

Mr. NELSON. Mr. Chapman?

Mr. CHAPMAN. Thank you, Mr. Chairman.

As the newest member of this committee, and probably one with the least experience in matters that you are testifying about, I will not attempt to even get into the details and the technicalities of what you are doing, or what your recommendations are, other than, if I have heard you right—and, Dr. Fletcher let me ask you to comment on this. From a meeting we had a week or 10 days ago with the Members of Congress from Texas, in listening to the goals of the reorganization, both from a management standpoint and the work packages, a goal is centralizing the management and accountability, and that, of course, translates not only from the standpoint of management and put into the final hardware, ultimately, what is put in space as well. It seems to me on the one hand—and I want you to correct me if I didn't hear right—it seems to me on the one hand, that the good goal of centralizing management at headquarters, to have the kind of oversight and overview over the entire program, and that seemed to be a concept and a recommendation of General Phillips, which, as I understand the members of this committee, as well as members from Texas, all of the Congressmen from Texas, seemed to think make an awful lot of sense.

Yet, at the same time, in that meeting, I thought I heard you saying that JSC was going to maintain and would provide the technical direction, the plans and specification, the architectural services, if you will, for hardware, the prime contractor for which is going to be at Marshall.

Now, if it makes sense to centralize management in one place, how can it make sense to transfer a function from Johnson, the expertise, as I understand, historically for which is there or has been there, transfer that function to Marshall, yet attempt to maintain oversight, control, technical direction, plans and specifications, in Houston for something that is occurring hundreds of miles away? It doesn't seem to me that makes a great deal of sense, just from the standpoint of common sense.

Dr. FLETCHER. Mr. Chapman, maybe there is some confusion here. The technical direction wasn't over Marshall but over the contractor which is selected by the Marshall Space Flight Center.

As you properly point out that will be thousands of miles away in either case. So, that technical direction can be done just as well from Houston as from Marshall.

But the plan wasn't to move the people from Johnson to Marshall, that are going to do the technical direction. The plan was to keep them at Houston.

Mr. CHAPMAN. Well, then I guess that would be the question. The direction for that prime contractor will come from hundreds of miles away from where the work is being performed?

Dr. FLETCHER. Well, the work will be performed at the contractor, Mr. Chapman, if I understand General Phillips' recommendation, which may be in the State of Washington, or it may be in St. Louis, wherever that is, but it is a long ways away. That is normally the way we do our business, Mr. Chapman.

Mr. CHAPMAN. Well, is that the way the course— the way the program was headed, prior to the recommended changes, of what would be the difference in what General Phillips has recommended in that regard, as to had the program continued along the same track it was on, and apparently it has been on since 1982?

Dr. FLETCHER. I would like to ask General Phillips to answer that. But it was simply that the technical direction would always stay in Houston, but the contractor person doing the contracting of the habitability interior, the life support equipment, and so forth, the contractor that had the module would also have the responsibility for that life-support equipment. The technical direction would not change; it would stay at Houston.

But General Phillips may want to comment further.

Mr. CHAPMAN. Well, the guts—and let me add this one part of the question then—the tract that the program was on, as I understand, would have the guts, if you will, of the habitability module, the prime contract for that would have been at Houston, or is in Houston, perhaps, at this time; is that correct.

General PHILLIPS. No, no; and I think that is an important point of apparently difficult communication that has been going on now for some weeks here. I would like to try to help clarify it.

As I indicated, when this phase B work was launched on contract, some 14 or so months ago, the work structure that was established in those contracts assigned to Marshall, responsibility for doing the phase B work on a common module, and that is the large structure that constitutes ultimately the module for whatever its purpose. It assigned also to Marshall the responsibility for doing the phase B planning, and design and development for a laboratory module, the number of which, ultimately, is yet to be determined.

It assigned to Marshall the responsibility for the total development and design of the logistics modules, the number yet in the program, ultimately, to be determined. It assigned to Marshall the responsibility for equipping all of those modules with environmental control and life support systems, and basic features that constitute the completed module for its ultimate purpose.

It assigned to Johnson the responsibility for the major structure and truss, and the systems integration, to include the interfaces with the shuttle, with the power system, and the total integration work for this total station. It also assigned to Johnson the responsibility for equipping the habitability module with habitability fea-

tures, and equipping it with crew provisions and necessary crew interface.

The recommendation that I made was that the JSC—that Marshall be clearly assigned the responsibility for contracting for the development and ultimately the delivery of the completed modules to include the habitability module. That JSC retain the technical direction responsibility for the habitability equipping of the habitability module; the responsibility that they have had from the beginning.

Now, the other point I will make in my answer is that there has been competition in this program since the initiation of these phase B contracts that have now been underway for several months. Both the centers and their contractors have been competing with each other for the ultimate work.

I think that the degree to which the competing contractors, each working through the respective two centers, ultimately—the point I am trying to make is that they were competing for what the ultimate work would be, knowing that the definition of the ultimate work remained to be finalized in the request for proposal that is still to be issued, and on which the recommendations that I made were intended to provide some basis and assistance to finalize those decisions for the assignment of work.

The point there being that it wasn't entirely clear, in my mind, how without this final clarification of these responsibilities the ultimate work assignments would have, ultimately, been divided.

Mr. CHAPMAN. Now, that is the decision or the recommendation that you have made; is that correct?

General PHILLIPS. What I have just discussed are the recommendations that I have made, which Dr. Fletcher did approve and is now holding up on the implementation.

Mr. CHAPMAN. Precisely, where are we in the process as through the completion of stage B; where are we in the process of these potential competing prime contractors in the development of a package; and how is it that if the centers are competing against each other in these areas, that we know at this point that this certain work should be transferred to a certain center, if the decisions have not been made as to who will build the hardware?

Dr. FLETCHER. Mr. Chapman, I want to remind you again that there are two decisions. One is the recommendation that General Phillips made, and he has made it, and he has gone on to review the rest of NASA's program activities and, hopefully, we will come up with a more efficient NASA as a result.

The second is the standdown for 90 days, and what we are doing about that during this 90-day period. At the moment, the original recommendation stands, but we are reviewing all of that. We are talking to contractors.

Mr. Stofan will give you an update of where we stand on that.

Mr. STOFAN. Yes; the decisions were ready to be implemented; where were we on that? We had made—the first level set of decisions were made, we had defined, then, down the second and third level set of decisions of what it meant, ready to go implement those decisions. We needed more detail so people knew what to do. That set of decisions and write-up was done and we were about to issue it when we agreed to standdown; so we did not issue it.

So the clarity would have come into the system last week had we been allowed to go ahead, but we stopped, therefore, we did not implement any more of that decision.

The centers clearly understand exactly what we would have implemented. The competition would have ended that instant we sent that out. It was very, very clear what we were going to do.

I think it is clear to them, they have participated, and they have seen this detailed breakdown. In fact, the centers participated with John in generating this detailed breakdown. They said, if given the top decision, here is, then, the whole set of decisions that follow. They worked together, they generated, and the centers said, yes, we will sign up to all that, once the initial decision was made. So the centers understand it very clearly.

The contractors do not understand it as clearly because we did not issue this piece of paper, and then we took the interpretation of what the committee said not to do that.

Mr. CHAPMAN. Well, during this 90-day period, I heard, and I am not sure which of you testified, that contractors during the analysis of the review of these series of decisions, that the contractors will be consulted; were the contractors not consulted in the initial decision and if not, why not?

Mr. STOFAN. The contractors were; General Phillips talked with the contractors extensively the first time out. That was the first set of decisions.

Now we are talking about—now we are taking a review, setting those aside, we are saying, OK, they are set. Now I have been asked to take a look at the entire station design, operation, philosophy, international participation, and start this 90-day study to look at everything again, to come back and make sure we feel comfortable with where we are going and how the work packages are distributed. So it is kind of a first one and a second one. The second one we just started.

Mr. CHAPMAN. Are we at a point—am I hearing that the major difference, perhaps, if we are looking at the transfer of the work, the proposed transfer of the work, from Johnson to Marshall, that that work, the expertise is at Johnson, that the work could be performed but for the transportation of the shell, if you will, of the habitability module to Johnson, which would be some transportation required, of actual constructed, or in work in process hardware, if these recommendations were not implemented, then we would be looking at having to transfer some type of hardware work in process from Marshall to Johnson, and that that would be—and that is part in the prevention, or not having to make that physical transfer of that work in progress, am I hearing, provided a major portion of the rationale for the decision of transferring the work from Johnson up to Marshall?

General PHILLIPS. Yes. Without the recommendation that I made, be an alternative, the way the program could have gone, would have been for the module to be partially completed by the contractor under the Marshall contract, shipped to the contractor under the Johnson contract, to be completed and equipped with the habitability provisions. So that is one route it could have gone.

Another route it could have gone would be for Johnson to be given the job of developing a complete module.

Mr. CHAPMAN. Doing the whole thing?

General PHILLIPS. Doing the whole thing.

And Marshall to do a laboratory module under their contractor. So that is a route that the program could have gone.

The point that I have made is that I think that either of those two alternatives, ultimately, would be far more costly to the Government, than in one contractor's facility, with technical direction for habitability equipping coming from JSC.

Mr. NELSON. Will the gentleman yield?

Mr. CHAPMAN. Yes, I would be happy to yield.

Let me just ask one additional question, Mr. Chairman.

Isn't work in progress, being moved from one contractor to another contractor, isn't that just a very common technique and a very common way of building virtually anything in this country, or anywhere in the world, as far as that is concerned?

Again, I see the technical direction being in one place, and the work happening in another place, it looks like it would make a lot of sense to have the ultimate work being performed where the technical assistance, the expertise, the astronauts, the engineers, the architects, where they are.

Dr. FLETCHER. I think we are confusing, again, contractors with centers. The contractors are located all over the country. And the centers are only managing those contractors, or giving them technical direction.

The contractors, for example, at Marshall, as I recall, one of them is at Seattle, and the other one is at St. Louis, and that is where the work would be done. Now, the question is is it proper to transfer a module from one contractor to another, and does it save money by having it at only one contractor? I think that is what General Phillips tried to explain.

You have got to distinguish in your own mind the difference between a contractor who does the work, builds the packages and so forth, and the management of that contractor which is done by the two centers that we are discussing. The management of those two contractors hasn't changed; the technical expertise is still at Houston, and the management overall of the module is still at Huntsville, that hasn't changed in this realignment.

Mr. NELSON. If the gentleman would yield there.

Mr. CHAPMAN. Yes.

Mr. NELSON. What you are saying is that it really doesn't matter where the contractor is located, compared to the technical direction? You are saying the technical direction is going to be from JSC, but the contract work is going to be done wherever the contractor is located?

Dr. FLETCHER. That is essentially correct, Mr. Chairman.

Mr. NELSON. Well, if that is the case then, we certainly know that there are going to be contractor personnel under your arrangement at Marshall or under the old decision at Johnson, so there must be some benefit from having the workers and technical managers together; can you explain that?

Dr. FLETCHER. I don't think that that necessarily follows; the contractors, the building of the modules will be done at the contractor's plant back home. Now there will be liaison personnel, I sup-

pose, from the contractors at each of the centers, and how they will be distributed, I think, is a question that needs to be looked at.

General Phillips, do you want to add to that?

General PHILLIPS. Well, I would just add that it is standard practice for the Government center that is the contracting organization, to have extensive interaction with their contractor on a major development, which this is.

So, Johnson will, in fact, have extensive interaction with their contractors and that will involve people traveling back and forth, and even to some extent, liaison people living with each other. Similarly, Marshall and their contractors, that is standard practice.

Mr. CHAPMAN. Why does that sound terribly complicated to me?

It seems to me that you have got the contractor that will be reporting to Marshall, but the direction will be coming Johnson, technical direction will be coming from Johnson?

Mr. NELSON. When, in fact, the module isn't even in Huntsville?

By the way, Mr. Stofan, you said this was all so very clear.

Mr. STOFAN. There is one point that, I think, has to be made here. The point that General Phillips made before was accountability.

We want to hold a contractor accountable for delivering a totally checked out module that can be shipped to the cape and flown. One contractor totally responsible.

We don't want to have several contractors responsible for it, so that we don't know if it doesn't work; whose fault it is; why it can't go together; and we get it down to the cape, and we can't check it out. We want a contractor to be responsible for that module, totally end-to-end to check it out before the Government buys it off.

That is why we want Marshall to have control of the contractor. Now the technical direction to make sure that the stuffings in it are right, will come from Johnson.

But the contractor can be accountable to deliver the hardware; and that is what General Phillips recommended.

Mr. NELSON. Under the old system you are saying that it could not?

Mr. STOFAN. Under the old system it was split responsibility, because the module would be built by the Marshall contractor, partially checked out, and then shipped to Houston, they would install their equipment, and then after that, I don't know if we check it out again, or we send it to the cape, and then who is responsible for it. We tried to get one contractor responsible for that module.

Mr. NELSON. Are there any other items on the space station where there is a split responsibility?

Dr. FLETCHER. I am sure there are, Mr. Chairman. We will have to cogitate; but they are small compared to the one we just described.

Mr. WALKER. Mr. Chairman.

Mr. NELSON. The gentleman still has the time.

Mr. CHAPMAN. One additional question, when you talk about the module being shipped to Houston, does the same rule—the general contractor in Houston, does the same rule apply to him that whatever he is doing may be done in places other than Houston, as well; I would assume it would?

If the general contractor at Marshall is building something in Seattle, or St. Louis, or Sulfer Springs, or wherever it may be, would that same general rule apply in Houston, to the prime contractor, the general contractor there?

General PHILLIPS. Yes, it would.

Mr. CHAPMAN. So when you are talking about shipping the module to Houston, it may not go Houston at all, it may go to San Francisco?

Mr. STOFAN. That is correct.

Mr. CHAPMAN. Or New York City?

General PHILLIPS. To their contractor, yes, sir.

Mr. WALKER. Would the gentleman yield?

Mr. CHAPMAN. Surely.

Mr. WALKER. Just to try to understand this a little bit, if I can put it in the context of the Shuttle Program, can you tell me what was the responsibility of the Johnson Space Center with regard to the Shuttle Program, and then where and how was the work performed?

Dr. FLETCHER. Mr. Walker, I think I can answer that better than any, because I was there when we made those assignments.

That was organized a little differently. We had what we call level A nowadays, in headquarters, and that was overall program responsibility, but the systems engineering was done at Houston, which was the lead center, and that would be corresponding to level B, that Mr. Stofan was talking about.

So the systems engineering, analysis, and integration would all have been done at Houston on the space shuttle.

Now, under that would be, what would be called level C, in Mr. Stofan's terminology, and we had level C program at Houston to develop the orbiter itself, just the orbiter, the vehicle that returns back through the atmosphere. The level C contractors for the external tank, and the space shuttle main engine, that is the engine that went with the orbiter, and the solid rocket motors were all at Marshall Space Flight Center. And, of course, we also had level C at the Kennedy Space Center, which had the responsibility for check out.

So we had each of these level C with their own contractors. For example, on the orbiter there was primarily one contractor, and that is a level C contractor, which was at Rockwell. However, even in that case, there was another contractor who developed the computer, the four set of computers, which was done by IBM and, in fact, only three were done by IBM, and the fourth one was done by somebody else that I don't remember, because it was a backup to the IBM.

Now, in the case of Marshall, level C, again, the three contractors in the case of the external tank, was Martin Marietta. And in the case of the space shuttle main engine, it was a Rocketdyne division of Rockwell, a different part of Rockwell. And in the case of the solid rocket motor it was what is now called Morton Thiokol. So that is how work packages broke out there.

We did have the lead center concept there in which level B, indeed, was at Houston. We have on this case, decided to pull back for a lot of reasons, including the Rogers Commission complaint about the way we managed the Space Shuttle Program, and level A

then is now moved back to headquarters; and level A, or B, is partially at headquarters and partially at Houston.

Mr. WALKER. What you are saying here is that the old pattern at that time we are referring to here was essentially a shuttle model, is essentially the model upon which the shuttle contracting was done; what you are proposing here is a different schematic from what you did in the Shuttle Program?

Dr. FLETCHER. That is approximately true, Mr. Walker. I think in details one could argue about it, but essentially that is true, we did pull back the lead center responsibility from Houston, in the case of the space station, to headquarters.

Mr. WALKER. I appreciate the gentleman yielding.

Mr. CHAPMAN. That is all the questions that I have at this time. I know that there are other members that do have questions, Mr. Chairman.

Mr. NELSON. Mr. Flippo.

Mr. FLIPPO. Thank you, Mr. Chairman.

I would like—and I appreciate the indulgence of the committee in this extenuating situation—I wonder if you could tell me why the module and the environmental systems was assigned to Marshall in the first place; why assign modules to Marshall?

Dr. FLETCHER. That is a good question. And the three of us sitting here, probably these three weren't here when that decision was made, but I hate to dump this on John Aaron, but he is the only one here at this table who was there when that decision was made.

Mr. FLIPPO. They have any expertise?

Mr. AARON. Certainly, I think the reason that went into that was looking at the expertise around the agency, and looking at the weight——

Mr. FLIPPO. What is their history in developing modules, common modules, what is the history of the agency?

Mr. AARON. Well, I think the thing that they had in terms of capability was their spacelab experience as well as their skylab experience.

Mr. FLIPPO. Was that successful?

Mr. AARON. Yes.

Mr. FLIPPO. Any other centers have regular expertise, than Marshall, in regard to the module?

Mr. AARON. I think JSC and Marshall are the predominant ones in that regard.

Mr. FLIPPO. Could you give us some estimate of the cost of the shell and environmental systems and the development of the module compared to the habitability cost?

Mr. AARON. I can give you a feel for that. The functions of the module, General Phillips has already touched on, so let me just go through those briefly, because in addition to being just a shell of whole pressure, and gives the life supporting functions, we also have to maintain thermal control, safety provisions, life-support systems——

Mr. FLIPPO. I am sorry, I can't quite hear; could you pull that a little closer?

Mr. AARON. Sure.

Looking at the shell of the module and the basic outfitting of a module that is common no matter what kind of module it ultimately turns out to be, which is a function of the ultimate use of the module, equipping that with such things as power distribution, the life support function, and the thermal control function, basic safety provisions, because we have to maintain symmetry so if we loose a module we can go to the other modules and still maintain the safety provisions, communications, and the systems command and control. Those basic functions are common with any module that the United States puts up. Those in context of the contractor dollars, that we are talking of here, phase C/D prime contractor dollars, is an estimate of $400 million to $500 million.

Mr. FLIPPO. $400 to $500 million?

Mr. AARON. If you spread the designed and development cost across the production of two modules, which is our current configuration.

Mr. FLIPPO. And the habitability?

Now, can you give us some concept of the portion of—could you tell me something about the size of the cost of equipping the habitability?

Mr. AARON. The habitability function, that is to turn it into a specific habitation module, which includes the housekeeping equipment associated with the basic functions of housekeeping, food services, health maintenance, the furnishing, in terms of the bunks and accommodations, as well as the crew personal hygiene, is about, in round numbers, $200 million.

Mr. FLIPPO. $200 million?

Mr. AARON. Of the prime contractor contracted work.

Mr. FLIPPO. OK. So you are talking about the shell that has been talked about here is about $400 million——

Mr. AARON. Well, that is the shell plus the basic——

Mr. FLIPPO. I understand that.

Well, I am talking about what is assigned to Marshall at the present time is about $400 million, and the other is about $200 million; is that correct; that is essentially, I believe, what you said?

Let me ask General Phillips. You said in your statement that uppermost in your mind was to assure that you maintain clear contractor accountability. Could you tell us what is so important about accountability in fashioning work packages?

General PHILLIPS. Well, I think the clear assignment of responsibility and accountability in a large complex program is essential in order that program can be adequately defined, and properly managed and wind up with an efficiently produced end item. I think one of the problems that has occurred in many programs that I have observed over the years, has been a confusion of responsibility, whether it is within a Government organization or in a contractor. And where there is uncertainty, and confusion over what the responsibility and accountability is, I think the potential for difficulties arise. I think it is very important to have clearly stated the responsibility and accountability of each element in a program, including the principal contractor.

Mr. FLIPPO. So it includes reliability, and cost, and management, and all of those; it is the essence of it?

General PHILLIPS. Yes.

Dr. FLETCHER. And safety, Mr. Flippo, as well.

Mr. FLIPPO. I think we have heard a lot of discussion today about the cost of the recommendation, of General Phillips. Could anyone make me a comparison of the cost of the 90-day standdown, and what it costs you to maintain the contractors, with the cost of the recommendations of Dr. Phillips?

I mean, everyone here, we have heard testimony all day long about this great cost involved in this transferring; I wonder could you give us a comparison cost?

Dr. FLETCHER. I would hate to give numbers, but I can say this, that the cost of the standdown wouldn't be anything like the savings and the cost in terms of the proposed management structure by General Phillips. One would be in the hundreds of millions, and the other one would be in, possibly, millions; but maybe Mr. Stofan might have a better idea of what the standdown is going to cost?

Mr. STOFAN. We have not estimated that. I wouldn't want to make a guess at this time. We can go try to do that and supply it to you later.

Mr. FLIPPO. One more question and then I will conclude.

Mr. Stofan, you made the point, I believe you are looking at a redesign, the consequences of a redesign, and I wonder what role will the users play in your look; or what input will they have to you as you go about looking at a possible redesign—are you talking about some major mod; are you taking about some new component; are you talking—what are you really looking at?

Mr. STOFAN. There were several concerns that have been raised recently, the EVA hours for assembly, the EVA hours for maintenance, the shuttle throw-weight capability being smaller meant a repackaging. To address these issues, and other issues that were brought up, and that is that we were encouraged to have, in the assembly sequence, to have as much science up as early as possible, expressed by Boland's committee, looking at all of these concerns, that is the process we off doing.

Now, to prejudge the outcome of that, I wouldn't want to do that. There are thoughts, there are ideas, most of them have been played out in the magazines, but we would really like to go do it from an engineering point of view. And any recommendations that we come up with are going to be based upon technical costs and schedule impacts, and that is how the decisions are going to be made, or recommendations are going to be made.

Mr. FLIPPO. Well, appreciate very much the response of the gentleman at the table.

I particularly want to express my appreciation to the chairman for his consideration.

Mr. NELSON. On the question of the redesign, that is also part of where you are considering the input from some of the astronaut corps, with regard to the amount of EVA in constructing this station, et cetera?

Mr. STOFAN. Yes; in fact, this effort really has been going on for the last few months. These concerns were not brought into the system when they hit Aviation Week. These concerns were known and were being worked. It was recognized. And this is, I think, as a program is defined and matures, this type of thing is not unusual at all.

I would say we are in a normal process that we should be in at this time. As questions come up, and concerns come up, we go back into the structure that we have as running this program, and ask them to take a look at it and come back to us with recommendations of how we change assembly sequence, how we modify design, and, again, we call in the international people to become involved, and the utilization of the station, obviously, to make sure that we are using it properly; astronauts, again, are deeply involved in this process; and they all will be involved in the process when we come up with our answers.

Mr. NELSON. All right. Now, Mr. Aaron, you were quoted in that same Aviation Week article as having said that there is no doubt that changes are required, the problem is determining how to implement them; is that an accurate reflection of your statements at the time?

Mr. AARON. Well, relative to what I intended, there was no doubt some of those concerns were valid and some changes may have to be made as a result of that. We are working to understand how best to effect those. So, that would be the proper context, as I remember, that I made the comment.

Mr. NELSON. All right.

Well, what did you mean by that, that there is no doubt that changes are required?

Mr. AARON. Well, I think in the context of the phase B effort that we have, and understanding now that we've done multiple design loops on this configuration, we see cases of where there are parameters that are being stretched that we wouldn't like, necessarily, like to be stretched, and looking to see if we can desynthesize those a little bit——

Mr. NELSON. You have got to turn up the volume.

Mr. AARON. In the content—I think, it is back to the normal phase B comment that Andy Stofan made. Relative to some of the fundamental parameters of complexity of assembly, amount of EVA, although, I think we can potentially do that, that tends to stretch some parameters that we'd just as soon not stretch. So, we are looking as if there are ways that we can relieve some of those parameters as part of our next assignment.

Mr. NELSON. What does all that mean; does that mean that you are planning a reconfiguration of that dual keel; does that mean that you are planning to put up on early——

Mr. AARON. You are asking me to be judgmental, again, in terms of what the outcome of it is——

Mr. NELSON. I'm just trying to understand what you just said.

Dr. FLETCHER. Mr. Chairman, I think you are pushing some of our troops a little too hard. They are just starting to look at some of these things.

Actually, John has been looking at them for some months now, John Aaron; and Andy only for some weeks. These are legitimate concerns, the number of EVA's, the number of orbiter flights required, all of these things need to be looked at.

I think to ask them to come up and prejudge how the new configuration will be, if there is a new configuration, is pushing us to make a decision before we really made the study. I don't think—I

would hate them to make a guess as to how that is going to come out at this time.

Mr. NELSON. Dr. Fletcher, before you were ever called on to come back into the service of your country, a budget was submitted to this Congress by the Reagan administration asking for $410 million in fiscal year 1987 for the space station, thus far, we have supported you—you being NASA—on that request. There has been a lot of question on this committee as to whether or not that amount is justified, in view of the fact of changing ideas with regard to the design and the beginning of the bending of the hardware in fiscal year 1987, of which part of that budgetary request is addressed to. That is the context in which I ask questions. So, again, I asked Mr. Aaron, with regard to his comments where he is quoted as saying, "There is no doubt that changes are required," elucidate this committee with regard to your ideas.

Mr. AARON. Let me do so within the context of that. Relative to looking at the various parameters that we have analyzed in phase B, and various concerns, my judgment says that this configuration is a very mature configuration, and although I think we will have to—and I will give you my judgment again, and maybe I shouldn't do that, because I don't want to mislead you by not doing that—in my judgment, except for minor tuning of how we assemble this station, to both relieve some of the complexity concerns that we have come up with, as well as to get an early productive station with a minimum number of shuttle flights, I think that is a mature configuration, and with minor adjustments in the assembly sequence it is going to come out that way.

Mr. NELSON. Why did the astronauts' study dispute that; the astronauts study that Mr. Stofan referred to, was in the works for some time.

Mr. STOFAN. I don't think that the—it didn't dispute that——

Mr. NELSON. Well, let me get his answer first, before I get yours.

Mr. STOFAN. OK.

Mr. AARON. The astronauts study did not dispute that. The astronauts study was a reflection on the current way we were assemblying this vehicle as part of our SRR configuration. At the time that they came forward with the concerns relative to EVA and complexity, we were already studying those, because we had picked up those concerns ourselves.

When they were brought into the fact that we were analyzing some of the same concerns, they joined our team; and we are making great progress on tuning this configuration to relieve those concerns.

Mr. NELSON. I don't doubt that all that—that there is a consensus emerging and, hopefully, we will be the better off for it.

All right, Mr. Stofan, you have got a dual keel, Mr. Hodge came here and talked to us about that, at the same time there is concern in the astronaut study, as being voiced about too much EVA on that dual keel, a question of redesign of the modules, so forth; you want to address that for us?

Mr. STOFAN. I think the concerns, yes, were brought forward, and as I say, by the time they were brought forth publicly they were brought forward internally; and at the working level, they were

working on these problems some time ago; they knew that they existed. And this is typically the way the systems work.

Eventually, a problem will be identified; they will work on it a while; they will bring it up to management and say: we have a recommendation to handle this problem that we have discovered; that process had been going on. And their concerns were real concerns, and they were verified, the EVA hours were what we considered to be required, we were uncomfortable with them; so they went back and said, OK, now that we know what we can do to alleviate that concern; do we have to change the entire design; can we do it with a different assembly sequence, and that process we are right in the middle of now.

We have brought in all the centers and we brought in all of the contractors this week, to go take a hard look at that, and John says he has a gut feel, having worked on this a couple of months with the people, that there may be an answer that comes out of that which is not a drastic change. But we have to verify the process. We are right in the middle of it and I hate jump to the end conclusion.

Mr. NELSON. OK.

Mr. AARON. I think in context of that, I think it is important that I at least highlight what the design process is, because relative to arriving at the baseline configuration, we had done that as part of about the first 9 months of phase B, by analyzing multiple configurations to a certain level of depth, in terms of depth analysis and detail and characteristics. Having arrived at one that looked especially promising, we then started into the three or four months phase that we called, preliminary design.

That was actually there to validate the configuration that looked the most promising, to make sure that there was any catch, or hiccups in that configuration for 3 or 4 months before we then go out with the RFP for phase C/D. That is the phase of the program we are in.

We are in the preliminary design process, and as these minor concerns show up, it is not unusual to adjust those before we go out with the final phase C/D RFP's. So, I look on it as a very normal process that occurs in phase B.

Mr. NELSON. Final RFP to be issued when?

Mr. AARON. We were on a course to issue the RFP, except for the standdown period, in October.

Dr. NELSON. It will be when now?

Dr. FLETCHER. As I mentioned, Mr. Chairman, we really haven't come up with the decision on when the RFP's will be released, because it does depend on how large a change in the configuration, if any, we decide to suggest to you. It has only been 10 days or so since we agreed to standdown, and I think it is premature, but certainly it has a good chance of being delayed some.

It could be as late as 90 days, I suppose; or it could be as little as one month.

Mr. NELSON. Now, are you saying that the RFP is going to be delayed because of the 90-day standdown vis-a-vis the Houston versus Huntsville question?

Dr. FLETCHER. Well, I am not sure they are unrelated. We agreed to standdown for 90 days partly because of all of the confusion, and

Congress, and the wild statements that were floating around, to let things cool down a little bit. But partly because of the these concerns that you have just raised.

Mr. NELSON. The design question?

Dr. FLETCHER. The design question, yes.

It was both reasons.

Mr. NELSON. When the President submitted his budget to the Congress in late January, asking for $410 million for the station, it was predicated on the basis of a RFP coming out at least by October 1; how can you justify the $410 million, since there will be a delay on the RFP?

Dr. FLETCHER. Well, you have to be a little careful about how that $410 number was arrived at. My recollection—and if I am off the track, I am sure that Andy will correct me—$250, something like $250 million of that was for the completion of phase B, which will have to be extended if we extend the—if this 90 days has an impact on that October date.

The rest of it, which, I guess, would be $160 million, was for the start of the contracts, the winning contractors. So in that connection it may be that less money would be required for the winning contractor, and more for the phase B study, if we, in fact, do delay a significant amount.

Mr. NELSON. We will visit with you further on that subject.

Mr. Andrews.

Mr. ANDREWS. Thank you, Mr. Chairman.

I would like to ask you all to address the decision as it affects the work package realignment, properly capitalizing on dollars already spent and facilities that are already in place. Let me give you an example.

In fiscal year 1986, and 1987 the committee authorized funds for facilities at JSC and Marshall that would appear to me to be inconsistent with this work alignment. For instance, JSC justified a facility that includes a manned systems test bed. In 1987 we spent $5 million on it, and $5.7 million was spent in fiscal year 1986 and previous years. Marshall requested at the same time, $2 million for a propulsion test stand, with $1.4 million spent in previous years to develop that stand.

In the budget justification that you submitted to Congress, or that NASA submitted during that time—let me read some of the language as it relates to the propulsion stand, "Marshall is the lead center for space station propulsion activities, with responsibility for full systems development and testing."

That budget language also provides an unquestionably strong justification for integrating the habitability module at JSC. I guess the question is how, first, is Congress to take these justifications, are we to take them seriously when they were made back in 1986, and does it make sense to spend the kind of dollars we have already spent on the manned systems test bed, for instance, just to use that as an example, and go forward with this reorganization plan that seems inconsistent with the path we have been on previously.

Mr. Stofan.

Mr. STOFAN. Yes; the thing is that it is totally consistent, because I think there is a lack of understanding here. The test beds were

never moved, they were never intended to be moved. The responsibility for the test beds for the habitability module has been assigned to JSC from the day one, and it will be, and that has not been affected at all. So, to have the C of F money, or building these things at these centers, that is where the technical expertise is, and that is where it will stay. We never intended to move that.

The same as Marshall, the propulsion test beds were for research and technology and hydrogen oxygen engines, that is where the expertise resided, and that is where the test beds will be used in the future to do the R&D and advanced development of hydrogen rocket engines. So, this is consistent with the set of decisions that were made——

Mr. ANDREWS. Well, I guess, let me just ask you to describe for us how you expect the results of the work done at these test facilities to be effectively used in the development of programs taking place a thousand miles away?

Mr. AARON. Well, it goes back—let's take the manned systems test bed. The Johnson Space Center still has the technical direction responsibility for the manned systems and the habitability module outfitting responsibility, in terms of doing the management and technical direction of that piece of the Marshall contract.

They will need that manned systems test bed at the Johnson Space Center to understand the architecture and top-level engineering analysis to aid them in the execution of effecting that technical direction to Marshall's contractors.

Mr. STOFAN. To expand on that a little further; I think philosophically it goes deeper than that. NASA has basic research centers, three of them that conduct basic research, Ames in California, Langley in Virginia, and Lewis in Cleveland, who have technical expertise in many different areas.

The technology is developed in these centers which eventually ends up in all the high technology things NASA has done. So, that tech transfer, internal to NASA, has been going on from the day NASA was founded, and NACA before that.

So, we know well how to keep that technology transfer because it is not always developed at the center where it is used. In fact, it is probably rarely developed at the center where it ends up being used.

Mr. ANDREWS. But still, though, with your reorganization plan, are you not now going to be required to do mockups, test stands, at these various facilities, that you would not have had to develop——

Mr. STOFAN. No; there will be no more mockup or test stands than we planned originally, not one.

Mr. ANDREWS. Let me ask you to focus on the dollars that we have already spent to some of the contractor teams; and correct me if I am wrong, but as I understand, McDonald-Douglas, received about $22 million for the phase B effort, Rockwell received about $27 million of their efforts, with the change now, how much of that dollar figure can we say is lost, is wasted?

I am not trying to make a joke, but——

Dr. FLETCHER. It is pretty hard; can we supply that for the record Mr. Andrews, that is a complicated question. We would have to make best guesses, and a lot of people would be involved in making that judgment.

Mr. ANDREWS. You don't—then do I understand then, Dr. Fletcher, that you do not know how much of the dollars that we have already spent to these contractors will be lost as a result of this reorganization plan?

Dr. FLETCHER. We are not sure any of it will be lost, but if there is any, we would have to examine that very carefully.

If one of our people wants to make a guess, fine.

Mr. ANDREWS. I understand that you don't have that information today, I am surprised. Do I understand that you did not, and you have not made that analysis prior to the June 30 decision.

Mr. STOFAN. The cost of anything lost would be very, very small. And no, we haven't figured out what that very small thing is.

All of the money that has gone into these contractors, they delivered end-item packages to us that defined how they were going to do it, what was the technology and what went into those studies; those end item things that they delivered to us are as valid today as they were before we switched.

If the subcontractor now reports to a different contractor, all the money that he had developed will end up in the program as much as it ever was before. So, the number has to be extremely small. I don't want to say it is zero; but I can say it is very, very small.

John?

Mr. AARON. I don't have an estimate of that. The contract for phase B was to deliver products which we would use regardless of a particular contract——

Mr. ANDREWS. Well, could we see, I just used these two as examples here. I wonder if you all could come up with some calculations on what those loss of dollars are, what small means?

Dr. FLETCHER. We are not sure any of it is lost. But we will try to make a best guess for the record.

[The information follows:]

The phase B contracts are fixed price contracts and there is no accounting by NASA of how much money is spent on each task required in the contract. The contractors have also been spending their own independent research and development money during this phase of the Program and that money is not reportable to the government. The reassignment of the propulsion subsystem is the one obvious work package change that could be assumed to be a loss.

Mr. ANDREWS. Dr. Fletcher, I mentioned earlier, and Mr. Aaron gave his best estimate on this, but as I mentioned the Clear Lake Economic Development Council has done a fairly extensive study that is not yet complete, about the impact that this program will have on investments already made by the private sector, the investments that were made prior to June 30, in anticipation of the program going in one direction, and as a result of that they came up with a number that real estate infrastructure, real estate infrastructure, is a $10 million investment. Commercial and industrial facilities about $170 million have been invested in the area in anticipation of the program. And industrial equipment and hardware purchased by aerospace companies to work on the station is about $12 million. Has NASA done their own study to evaluate what the costs will be and what will they have been, and what may be lost as a result of this reorganization plan?

Dr. FLETCHER. The quick answer is, of course not. We don't normally make those economic cost studies. These are estimates formed by some private organization.

We will be glad to look over their estimates, if that is what you suggest, Mr. Chairman. But we normally don't do that.

We don't think the cost of this management change on the Houston economy is going to be significant, except, possibly, the loss of potential job increases. Again, I have agreed to standdown for 90 days while we look at the numbers again, and maybe change the configuration. But we don't normally make estimates of that sort, Mr. Andrews.

Mr. ANDREWS. Well, I will respect your judgment about that Dr. Fletcher. But the truth is you haven't made any estimates to base a judgment on that the costs will not be severe.

You know one of the goals that we have had in our hearings has certainly been to encourage private development in outer space, commercialization of the Space Program, and as you and I have discussed, the manned systems technologies expertise that has been developed at JSC within the Houston area has literally attracted talent from all over the world because of that expertise.

I think a real concern that all of us from Texas have, and other members of the committee not from this State, and certainly members of the Appropriations Committee, not from Texas, is that in making this major change we may well be hurting our overall long-range goals of encouraging the very kind of private investment, private talent to get involved in the Space Program. And it is amazing to me that no in-depth study was made of the effect of this decision on private enterprises.

I am not suggesting that every time you move 100 people, you have got to study the economic effect, or notify the Congress. But surely a move that by your first estimate that you verified, could cost the Houston area many jobs, and cost many millions of dollars in prime contract dollars alone, that you wouldn't make some kind of base study to try to get an appreciation of what affect your change may have the long-range goals of encouraging private enterprise in outer space. A little bit tangential to what the local effect that would be on the Houston economy, but very important to the long-range goals of our space program.

Dr. FLETCHER. I will just have to repeat that NASA has never done that kind of a assessment. We don't normally make economic impact assessments, as you call them.

If we are required to do so, I guess Congress can pass a law. But normally, nobody, not the Defense Department, nor us, or anybody else makes those assessments.

Having said that, however, I am well aware of the economic situation in Houston. I think we ought to do what we can to alleviate that, when we can do so legally. We have tried to, as much as possible, do so in the past.

My daughter, as I mentioned, lives there; and they are well aware of the problems of selling houses and all of the awful things that you know about in Houston.

To the extent that we can do so, we will try to alleviate those problems. On the other hand, we normally don't make those economic impact assessments that you described.

Mr. DELAY. Would the gentleman yield on that very point?

Mr. ANDREWS. Surely.

Mr. DELAY. In the economics of Houston aside, do you believe that the economic impact on prime contractors has anything to do with the cost of providing a space station, or any other program by NASA?

Dr. FLETCHER. It is hard for me to see how it would have an impact on the cost to the government, Mr. Fields——

Mr. DELAY. It is Mr. Delay.

Dr. FLETCHER. I am sorry about that.

Mr. DELAY. Don't you believe that a company has to recoup its costs in order to make a profit and, therefore, charges higher prices to the Government, based upon decisions by the Government that would cost them money?

Dr. FLETCHER. What costs them money is that every time you change your mind about what the contract will consist of, and that is bid and proposal money and it is——

Mr. DELAY. You don't think it cost the company money to move to facilities from Huntsville to Houston, or Houston to Huntsville, or up to Washington or back and forth, that doesn't cost the company money?

Dr. FLETCHER. Sure it does. We are not proposing to do that.

Mr. DELAY. That is not reflected in the cost to the Government?

Dr. FLETCHER. There is no movement of that sort contemplated.

Mr. NELSON. the committee will stand in recess. We will go and vote, return immediately and resume.

[Recess.]

Mr. NELSON. The committee will come to order.

We will call on the gentleman from Texas, Mr. Delay?

Mr. DELAY. Thank you, Mr. Chairman.

This simple-minded boy from Texas is as confused right now as when he walked in the room earlier. I just want to kind of summarize something, and would invite anyone of you to interrupt me when I say something wrong, and please clarify what I am having to say.

Before the decision of June 30, the situation was that Marshall Center was designing and developing the shell, and JSC was designing and developing the stuffing; that is not correct?

Mr. STOFAN. Partially correct.

John, again?

Mr. AARON. Well, that gets back to the summary I made previously. In addition to Marshall designing the shell, they were also doing basic outfitting of it to make a generic module, which includes life-support power systems and basic provisionings, that you could then have a generic module with generic kinds of support——

Mr. DELAY. But you are confusing——

Mr. AARON [continuing]. From which you then make a unique module out of. You either go one level above that and make it a lab; you go one level above that and make——

Mr. DELAY. Right; you are confusing, again. That is exactly what I meant, was that they were building a module that could be used for habitability module, or laboratory module, or whatever——

Mr. AARON. Logistics module, right——

Mr. DELAY. That is what I meant by the shell.

JSC was to develop the habitat part of that shell that Marshall—and you wanted to consolidate that with one contractor, rather than have it built—the shell built by one contractor, moved to another contractor, and have it stuffed; you wanted one contractor to do both? I have no problem with that.

What I see that your June 30 decision, based, quite frankly, on the lack of hard costs increased costs, or savings, and based on not checking with contractors—and I disagree with you, Dr. Fletcher, that cost to a contractor does increase cost to the Government, because the contractor is in the business to make a profit, and especially with new tax reform where you do away with investment credit, it is going cost the Government even more.

But, be that as it may, the way that the decision was that you wanted one contract that would be controlled by Marshall; is that correct?

That you would move some expertise from JSC in order to be in that management program—program management mode, through Marshall?

Mr. AARON. Not moved; not physically moved.

Dr. FLETCHER. No; we aren't going to move people physically. They are going to technically direct the contractor from Houston. The contractor, of course, will be at his contractor location, wherever that may be, but not at Huntsville.

Mr. DELAY. But Marshall would control the contract?

What is wrong with having one contractor building both parts, the shell and the stuffing, and you write the specs for the stuffing through JSC, you write the specs for shell through Marshall, you combine those two specs into one contract, award it, when the shell is built under the direction of Marshall, the contract shifts to JSC?

Dr. FLETCHER. I suppose there is nothing wrong with that. You can do the same thing by transferring people from JSC to Marshall, and doing it all at Marshall, either way.

Mr. DELAY. Except that what we have is what I think, under the guise of being more efficient, an inefficient system, where you have one person running the entire show but taking direction from JSC; Marshall running the contract and when they get to the stuffing phase of it, they take direction from JSC, but Marshall still has control?

Mr. STOFAN. Transferring a contract from one center to another is not an easy thing to do, and that would probably end up being inefficient. The way we are doing it now, I think is the most efficient way we could do it.

We are getting the technical expertise that can be applied to it. And they will develop the specification; and they will make sure the specification, Johnson will, of the habitat material is the way they want it to be.

Mr. DELAY. Well, what if you run into a disagreement between the program manager at Marshall, and the technical expert from JSC?

Mr. STOFAN. That is why they pay me my exorbitant salary. They will bring it to me.

Mr. DELAY. To make the decision of the dispute?

Mr. STOFAN. Yes.

Dr. FLETCHER. Sir, that is not an unusual routine. General Phillips and I are both familiar with the technical direction which was done for all of the ballistic missile programs of this Nation, and that is the way they carry out their programs with TRW doing the technical direction and various other contractors supplying the hardware.

Mr. DELAY. I have no other questions.

Mr. NELSON. Mr. Fields.

Mr. FIELDS. Mr. Chairman, thank you very much. I apologize for missing much of this hearing. We have a rules debate going on that involves Texas because of some oil overcharge fees, and I had to be there. So, if I ask a question that has been asked, please forgive me.

But in my opening statement earlier, Dr. Fletcher, I expressed some concern, and some concern that like my good friend from Houston, Tom Delay, I am confused. When you were in Houston, Friday, a week ago, you said your decision was final on your June 30 proposal.

Last Thursday you said that the decision would not be implemented for 90 days. I would like to know why you changed your mind?

Are you confused; are you insensitive, perhaps, to what some of the people down at Johnson are going through at this time; or are you open for consultation with Members of Congress and others about your proposed decision?

Dr. FLETCHER. Mr. Fields, I have to say something; I am not sure I ever said what you have just quoted me as saying. Sometimes the papers don't quote you exactly.

All I said was the decision, my decision at that time, to move the management of the program back to Washington, as far as I could tell, was final. I hope I said, but I would have to look at the tape to be sure, is that there is a lot that has to be done on defining the work packages.

Mr. FIELDS. Well, why did you come back then, last Thursday, and say, I have decided not to implement that decision for a period of up to 90 days.

Dr. FLETCHER. Well, again, I want to distinguish between two points. One is the management decision to bring the management of the program back to headquarters; and at this point there is no indication that we would reverse that decision.

The other part of the decision was the work package decision, and that is the one that we are still working on. Why we agreed to standdown is fairly clear; there were a lot of loose numbers floating around, some of them by Members of Congress, some of them by our own organization, which I apologize for.

We thought things ought to settle down, cool down for 90 days while we looked not only at the work packages, but as Mr. Stofan and Mr. Aaron both indicate, to look at some of the other concerns that people have had about the way this whole package, this whole space station, was going to be put together. Those things are the reason we agreed to standdown.

Mr. FIELDS. Well, when you tell me there are loose numbers floating around, does that mean confusion, or lack of preparation, or lack of study, or lack of coordination?

Dr. FLETCHER. I would say mostly on the part of Members of Congress, and some people at NASA, we hope to put together a baseline statement of numbers last—a week ago, Thursday, I guess it was, and that still stands. This is on numbers of people.

That doesn't mean it is accurate, it just means that is the agreed upon numbers of jobs, because we can't estimate things that closely.

Today, we had to make another statement on the division of the work between the two centers, and that also is an agreed upon baseline number. I think Mr. Stofan indicated 37 percent for Houston, and 36 percent——

Mr. STOFAN. Even.

Dr. FLETCHER [continuing]. Well, whatever; about even between the two centers. That, again, will not stand up; that is a baseline.

But I think it is better to let things cool down. I hope you get your information from the management of the program, which at this point is the Associate Administrator for the space station, Andrew Stofan.

Mr. FIELDS. Let me ask you about some information that we got from you, your press release. Because, again, I may be confused about something, and I apologize if this sounds sarcastic, but the last sentence of your press release says that you plan to conduct extensive conversations with Members of Congress during this period so there will be a complete understanding of the direction we plan to go.

Now, you were making this statement at the same time that a number of us were before the House Appropriations Committee. I want to know why you made this statement at the same time that we were before the Appropriations Committee, because if someone is naive they might think that there was not any tie between this statement and our activity between the Appropriations Committee.

I am not naive and I wonder if, perhaps, this statement was made so that we would fail before the Appropriations Committee. I hope you are going to tell me I am wrong.

Dr. FLETCHER. No; in the first place, it wasn't a coincidence at all. You are absolutely right on that.

I can go through the sequence, if you would like.

Senator Gramm, who testified earlier, and Senator Garn, who hasn't addressed this committee, both felt that there ought to be a cooling off period while we let the numbers sink in that we gave them the previous Thursday—gave all of you the previous Thursday—and let's let things settle down; let's have extensive conversations with Congress, as we go along. I agreed to do so.

Mr. FIELDS. So, you are saying that your announcement Thursday morning was intended to undercut our efforts at the Appropriation Committee level?

Dr. FLETCHER. I didn't say that. I said I did it at the suggestion of Senator Gramm and Senator Garn, as a cooling-off period. I don't know what was in their minds. I, personally, had nothing to do with your proposed amendment.

Mr. FIELDS. Let me ask, who, specifically, within NASA, has advocated the moving of the habitation module from JSC to Huntsville?

Dr. FLETCHER. As far as I know, it has always been at Huntsville, sir; the habitability module has always been at Huntsville since the beginning of the program; I may be wrong.

Mr. FIELDS. But the transfer of the work from JSC to Huntsville, who has advocated the moving of——

Dr. FLETCHER. You are talking about the stuffing, I believe. I think the first indication that was a wise thing to do came from General Phillips' task force.

I decided to go ahead and implement it, but, again, agreed later to standdown for 90 days.

Mr. FIELDS. Well, in one of the meetings that I participated in with you, you said that Houston would continue to be the focus for the space station?

Dr. FLETCHER. Yes; indeed, as far as the manned part of it is concerned, the habitability part, maybe is a better expression.

Mr. FIELDS. Well, has there ever been a study done or consideration given to moving the work that is at Marshall, that deals with the space station, moving that work to Houston, to JSC?

Dr. FLETCHER. As a matter of fact, that was done at the same time we moved the propulsion for the space station from Marshall down to Houston. And don't say Houston doesn't have capability for propulsion, because they do. They built the propulsion for the Lunar excursion module, and did a very fine job in that area, as General Phillips can testify.

Mr. FIELDS. Let me just close with the last statement that you made. Houston does have capability. I think that those of us who are in the Texas congressional delegation have capability, and to say that we are concerned and confused, I don't really underscores our feeling. I don't think I need to tell you this because we have had member after member from our delegation, and from the Senate, and I just hope that you are reading us loud and clear.

Dr. FLETCHER. I think I get the message, Mr. Fields.

Mr. FIELDS. Thank you.

Thank you, Mr. Chairman.

Mr. NELSON. Now, the delicate situation that we, as a committee have is to try to get all of this stuff behind us so that we can get moving on, and so that this country can get moving on with the program. I wish that all of this stuff didn't have to happen, but nevertheless, it does. So, here we are.

Now, let's see if we can move on.

Are there any other members of the committee that have any questions or comments at this point?

Mr. CHAPMAN. Mr. Chairman, I do have just a couple of more questions I would like to ask.

I beg the indulgence of those testifying, that I guess I am still a little confused as well.

Mr. Stofan, your headquarters will be in Washington, I assume; is that correct?

Mr. STOFAN. Yes.

Mr. CHAPMAN. I heard you answer a few minutes ago that when there is a conflict between the technical direction from Houston and the project manager in Huntsville, AL, that Washington is going to settle the dispute. It just occurs to me the incredible inefficiencies that the centralization of management, that everybody

supports, designed to fix, that you are creating those same types and inefficiencies with the recommendations of this project changing.

I am one member that, as Mr. Fields said, I don't think that makes any sense at all.

Mr. STOFAN. The thing is it is designed to make it efficient, that there are clear lines of authority from the program office in Washington that will run, that have authority to run the entire program. It is a very clear line of authority to the center, and if there are differences, that is where the decisions are made.

It is a very efficient management structure, and that is why General Phillips recommended it.

Mr. CHAPMAN. Well, if there is any inefficiency in having management in one location, it would seem to me that this project would scream to have—whether it be in Marshall or in Houston—that it would scream to have the technical direction, the architect, and the project manager, all in a position that they are working together, where there is no conflict, and there, obviously, will be, I am sure, daily conflicts in the technical direction from Houston and what the project manager in Marshall is doing; I would think you would be spending all your time refereeing those kinds of problems that could be worked out, perhaps, in a different way.

In other words, it seems like the more efficient thing would be to have centralized control of the project manager and the technical direction, perhaps, even dealing with separate contractors, as I am sure they will, as opposed to having one contractor trying to receive signals, not only from two different centers, but then from Washington as well. It just seems terribly inefficient to this member.

Mr. STOFAN. I think the overriding consideration is to remember that each one of the centers is building a contractor—they are responsible for contractors to build and deliver a checked out piece of the space station, and the Europeans, and the Japanese, and the Canadians are providing a part. Washington, the office that is located in Washington, the systems engineering, has to make sure that all of that goes together.

So, every time there is an interface, where it is a Marshall contractor, or Johnson contractor, if there is a difference of opinion there, that is settled by the Washington office exactly the same way, that is a very large job to make these elements coming from all over. And, yes, those decisions, the only place they can be made is in Washington; they can't be made anywhere else.

Mr. CHAPMAN. Let me, Dr. Fletcher, in the numbers that were being bounced around 1 week or 10 days ago, whenever that previous meeting was——

Dr. FLETCHER. A week ago, Thursday, Mr. Chairman.

Mr. CHAPMAN. As far as in looking at the employment levels at JSC and at Marshall, and we were talking in terms of 12,000, and give or take a few hundred now, of those numbers can you tell me ballpark, how many of those are civil service Government employees, versus how many are working for some contractor, private contractor, subcontractor?

Dr. FLETCHER. Yes; we had those numbers for you a week ago, Thursday, I hope you didn't—John Aaron or Andy brought them along with us today?

Mr. AARON. I think we talked previous about the fact that relative to the numbers that Dr. Fletcher released, those assumed that the civil service levels at the respective centers did not change as a result of this decision, and therefore, all the numbers that were on the release were the support contractors in a local Houston area.

Mr. CHAPMAN. Now, was the 12,000 and 13,000 figures, those were——

Dr. FLETCHER. No, the 12,600 number were both civil service and support contractors.

Mr. AARON. The base numbers, there are about 2,300 civil servants at JSC.

Mr. CHAPMAN. OK; so would that defeat that ratio—would be approximately be equal, both at Marshall and at Johnson; 2,000, 2,500, maybe 3,000?

Dr. FLETCHER. No; I think there are roughly the same number of civil servants, but the number of support contractors is much larger at Johnson Space Center than it is at Marshall Space Flight Center. I don't happen to have in my head the number of support contractors, but it is much smaller in Huntsville, than it is at Johnson—do you have those?

Mr. STOFAN. I don't have the numbers; but it is much, much smaller, the weight. But the civil service work forces are about the same between the two centers.

Mr. CHAPMAN. So, for purposes of my next question, that was the information that I needed, because in previous discussions when we were talking about the actual work being performed by the general contractor and the subs occurring at places other than Houston and Marshall, the fact of the matter is, from what I am hearing you say now, there are some 10,000 employees at Johnson, JSC, that are not government employees, that are working either for the prime contractor or the subcontractors?

Dr. FLETCHER. That is approximately correct, Mr. Chapman.

Mr. CHAPMAN. That would seem to me to say then that there are an awful lot of jobs that are going to go to the center. You say that the work is being performed, perhaps, in Seattle or somewhere else, there is an awful lot of private employees that are at the centers, themselves, in addition whatever else those contractors may be doing?

Dr. FLETCHER. Yes; indeed, there is a wide variety of contractors at the center, most of them, of course, with the Space Shuttle Program. In terms of the operation and the detailed design, the software changes, and so on, and so forth, most of them are what we call support contractors, in support of the Space Shuttle Program. Some of them, however, are contractors in support of the space station; but not very many yet, because our funding is very small for the space station at the present time.

Mr. CHAPMAN. But as the work packages develop, as the the contracts are let, and, perhaps, as there may be a diminishing of the shuttle program in some respects, it would be fair to say that there are going to be a tremendous number of people that are working, either at Johnson, or at Marshall, or at the other centers, that are

the employees, not of the Federal Government and NASA, but are employees of private contractors?

Dr. FLETCHER. Yes; those were the numbers that we estimated for you a week ago, Thursday. I don't have them in front of me, but the estimated increase of support contractors, as I recall, was somewhere between 1,000 and 1,500.

Do you have them John?

Mr. AARON. It is in the range of 1,400 additional, up to 2,400 additional support contractors associated with the space station buildup over the coming years.

Mr. CHAPMAN. OK. I wanted to be sure that is what I thought I had understood a week ago, last Thursday. I didn't want—I had gotten the idea, perhaps, from what you were saying that all this work is going to be going on in Seattle or San Francisco, or someplace else. And a lot, in fact, I guess, a majority, at least a significant portion of the private employees are going to be at the centers where this work is being performed?

Dr. FLETCHER. That is still the case, Mr. Chairman. I hope that we don't change those numbers before coming back to you and officially change them, even though you may find weird numbers leaking out of other parts of NASA. Just rely on us to give you that.

Mr. CHAPMAN. Dr. Fletcher, it is not the numbers so much that I am interested in as to try to get some kind of feel for the total work that is going on, what percentage of that work is being done in the private sector. It is obviously the vast majority of the work from the standpoint of employees.

Now, one other thing and then I will be through. I appreciate the indulgence of the chairman.

But I have heard you repeatedly refer today as the standdown as cooling off period. I heard Senator Gramm refer to it as a period of time in which there would occur a reexamination, a reevaluation. Dr. Fletcher, I have not heard that coming from any of the panel that are here. In fact, to the contrary, reading between the lines, what I am hearing is that your mind is still made up on this issue.

I want to ask you a question directly; is the decision as far as the transfer of the work that—the announcement that was made on June 30—what is your position at this point as to whether or not that decision is irrevocable; is it subject to reexamination and change; and what is your position at this point as opposed to a cooling period, which I think of—you know, we were all somebody in some kind of slugfest, and we are trying let tempers cool, I am more interested now in about the merits of that decision; is that decision still cast in concrete, or is NASA examining, truly examining that decision with the flexibility that it could change?

Dr. FLETCHER. Mr. Chairman, of course, we will consider the option of changing. But I hope that you didn't get the wrong impression. I think we have said quite a few words on the possibility of a change even in the design and the operation of the space station. And all of these things will be taken into consideration during this 90-day period.

I called it a cooling off period, perhaps, that was a bad term. It is a cooling off period and it is a period of addressing some of the fundamental issues that have been raised with regard to the space station, one of which is the change in the work packages.

Mr. CHAPMAN. Well, I would hate, as I heard before, that the cost, perhaps, of this cooling off period, this 90 days, I thought I heard someone say, could run up into the hundreds of millions of dollars?

Dr. FLETCHER. I think that is not correct, sir. I think we said it was very small.

Mr. CHAPMAN. OK.

That is all I have, Mr. Chairman.

Mr. NELSON. OK, as a follow up to that; Dr. Fletcher, in your statement that issued in a brief statement concerning the Space Station Program, after a press briefing that you attended with Senators Gramm and Garn, you say that: "Therefore, I have decided not to implement that decision for a period of up to 90 days."

I think what we would encourage you to do is do your consulting, and so forth, and don't delay; and make your decision on the basis of your consulting and your reevaluation; and report back to this committee as soon as possible; and then proceed.

Dr. FLETCHER. Well, I think that we will do that probably even before we make a final decision, we will come back to your group and the other Members of Congress and indicate the directions that we are planning to move. We don't plan to do this in the dark.

We don't know for sure how long it would take to look at all of the considerations that Mr. Stofan and John Aaron have indicated. As soon as we are ready to go ahead, we will come back to you.

Mr. NELSON. OK, what we don't want to happen is, No. 1, additional delay. If you have reevaluated and you have drawn your conclusions, report, so that it is going to go one way or another. The second thing that we don't want to happen is that you are ready to report but you can't report because at the end of 90 days is the end of October, and everybody is home, just prior to November 4.

Dr. FLETCHER. That idea had not occurred to me until somebody brought it up. I can't say it wasn't not in the minds of Senator Garn and Senator Gramm, but it was never discussed with me, sir.

Mr. NELSON. OK.

Mr. Barton.

Mr. BARTON. Thank you, Mr. Chairman.

I guess I think it only fair that we say a few good things about some of these tentative decisions. I have not heard anybody from the Texas delegation take offense at the recommendation to centralize the program management and to move the program office from Johnson to Washington.

I think Mr. Stofan indicated that might require the transfer of upwards of 200 people. It is apparent that if one has program office that also is a field office in the same location, the program office could give preference to the field office an allocation of resources.

So, the Rogers Commission did make some recommendations to centralize management; and I have not heard anybody on the Texas delegation take offense with that. That is about the only thing that I haven't heard them take offense with, but they have agreed with that one.

I don't want to beat the dead horse on the cost numbers. You all have stated that you didn't do a cost analysis. I have confidence that being men of integrity that you will do a cost analysis and show that to this committee.

I want to take a different tact, and talk about the decision process, itself. General Phillips, with the help of Mr. Hodge, made some recommendations, I believe that the total was 36, now I may be off a few on that. Dr. Henry Kissinger who was in this town for a number of years, talked about the "box mentality." That the decisionmakers couldn't make good decisions because the decisions that they were allowed to make were limited by the number of boxes; you could check box A or box B.

Dr. Fletcher, how many boxes were you given to check? The briefing paper that I have seen evidently shows that you were given the choice of accepting en bloc the recommendations of General Phillips, or rejecting en bloc; is that correct or incorrect?

Dr. FLETCHER. That is incorrect, Mr. Barton. A series of recommendations were made with regard to the space station, some of which you may have seen, but others were made not on briefing charts. And I had the choice of accepting, I don't know how many altogether there were, but a large number, I had the choice of accepting any one or all of them, or rejecting any one or all of them.

Mr. BARTON. But on any particular decision were there a range of alternatives, I mean, one alternative being, obviously, the recommendation that General Phillips and his people had taken great lengths to brief; one being the current status quo; and then choice C, that we know nothing about as of yet?

Dr. FLETCHER. Well, there were a range of recommendations, but there were also discussions back and forth between General Phillips, and myself and other members of the Space Station Program office. I don't think it is one bit, as we call it, type decision, yes or no decision, on any of those. In fact, it isn't at this point.

We only have conceptual decisions, as of June 30 they were only conceptual decisions. The implementation of those decisions, of course, has not happened, but the details would take until at least October on the original schedule.

Mr. BARTON. But you feel that you were given a wide range of choices then, and that you weren't presented with, "do this, because there was no other alternative?"

Dr. FLETCHER. No; there was a great deal of discussion, Mr. Barton.

Mr. Stofan reminds me that all of the center directors involved were present when that discussion was going on, and they all had their input into the decision.

Mr. NELSON. Would the gentleman yield on that point?

Mr. BARTON. I would be happy to yield.

Mr. NELSON. This is a copy of the presentation by General Phillips to you. As we can tell from this, there was only one option that was presented to you; and you are telling us in response to Mr. Barton, that there were other options that were presented to you?

Dr. FLETCHER. I think you will find on that chart there are a whole lot of choices on each page of that document. I could have rejected or accepted any one of those lines, on every one of those pages.

Mr. NELSON. Well, let's see.

Mr. BARTON. There is a press release that you state that you accepted every recommendation. Now, that may be an incorrect press statement. But I have got that somewhere in this pile of material.

Mr. NELSON. If the gentleman will further yield?

I will take your suggestion here, and I see "management review of space station program, work package content recommendations, direct following additional actions: Have module and airlock outfitting to MSFC; contract by MFSC; technical direction by JSC on Hab and EVA equipment layout and installation."

I don't see any other option.

Dr. FLETCHER. Is there any reason why I couldn't have rejected any of those items?

Mr. NELSON. Well, that is just one recommendation. That is what I am asking you as a follow up to Mr. Barton's question.

Was there another option that was laid out to you by General Phillips?

Dr. FLETCHER. There were an awful lot of options laid out by General Phillips that aren't on those charts. Those charts are the final recommendations after a great deal of discussion, as I mentioned, with center directors, with the program offices, and with myself. Only some of those appear on those charts.

Mr. BARTON. Well, as a followup, if the chairman will yield, I would like to ask General Phillips what his other option was that he recommended there?

What was the other option, if there were others?

General PHILLIPS. The option you have on the chart is what I recommended. That is why it appears as a recommendation.

Mr. BARTON. But what were the other alternatives to that particular recommendation.

General PHILLIPS. Verbal discussion of alternatives, some of which I have discussed briefly here during the afternoon. An alternative would be to develop two different modules; one under Johnson, to become a habitability module and——

Mr. BARTON. But that is not an option that you presented. My point is, and I think the chairman's point is, that if you re going to make an informed decision, you need to have alternatives. You made a recommendation and you should stand behind that recommendation; I am not ignoring that fact. But on an item of that importance, one alternative would appear to me to be, to remain the status quo, and what are the pros and cons of the status quo versus this change? There may be others.

General PHILLIPS. Just to respond to that point. The program could not remain status quo, because the status quo was indefinite and uncertain. Some decision had to be made.

Mr. BARTON. Well, then you need to explain that statement to me, I don't understand that at all. I have not heard anybody say that there was a performance problem at Johnson Space Center——

General PHILLIPS. I didn't say that there was, that wasn't what I said. I said that a decision needed to be made to finalize the definition of the work content to be assigned to Johnson and to be assigned to Marshall. A final decision to clarify how these modules were going to be designed, developed, equipped, and delivered, needed to be made; so a decision had to be made to assign the work one way or the other.

Mr. BARTON. But I am in correct in assuming that there is, or was until the decision last week to put everything on hold, a cur-

rent work plan and work package in place, with definite work assignments, with regards, not only to this particular item, but to the entire space station; that is not a correct statement?

General PHILLIPS. I hope I can respond to that without adding any confusion.

Mr. BARTON. I hope so, too.

General PHILLIPS. The request for proposal for the next phase of the program, for the so-called phase C/D, needed to have clearly established what the work that would be assigned to Johnson, and then in turn competed by their contractors; and the Marshall, and which in turn would be competed. The uncertainty that existed was the degree to which the design, development, and construction, and equipping of these pressurized modules would be done under the Marshall contract; and the degree to which it would be done under the Johnson contract. That was a decision that was required.

My recommendation, which is clearly stated, was that it be assigned in the way that I recommended. Now, we discussed the alternatives, and I won't go into them here unless you want to pursue it. But that decision was required to be made in order that the RFP's could be written and issued.

Mr. NELSON. If the gentleman would yield?

I do want to know what the alternatives are; that is what my initial question was.

General PHILLIPS. I have indicated briefly that one option would be for JSC and their contractors to develop a complete habitability module from scratch. And that would wind up being a different module. And Marshall would develop a module through their contractor, which would become a laboratory module.

Now, that is clearly an option that we discussed. I think that would be a costly, inefficient option, and in the long run would clearly not be the way to go.

Another option would be to partially complete a module under a Marshall contract, and ship it then to a Johnson contract, where it would be completed with habitability provisions and delivered; that option was discussed.

Mr. BARTON. Is that current assignment right now?

General PHILLIPS. I think that is what a lot of people think would have been the answer; but that answer was not clearly stated.

Dr. FLETCHER. That is what Johnson was hoping for, Mr. Barton.

Mr. BARTON. Well, this work package summary definition leads one to believe that that is the current situation. Now, again, I am not a NASA engineer, so I may misinterpret that, but that certainly is a layman's interpretation.

General PHILLIPS. Had I not been asked to review and advise, then how the work would have wound up shaking out, I am not certain. But it is possible that, as you suggested, that the inference is, that had I not recommended what I recommended, that a module would have been partially completed and moved to a different factory. I don't know that that is the case.

I can ask John to comment?

Mr. AARON. I don't think it would have.

The chart you refer to there, is the chart that we used for the purposes of dividing up the study aspects of phase B. And in the phase B–RFP we did say that we will adjust the scope of the work

in phase C/D as a function of what we learned both technically and managerial as part of the phase B process.

We had picked up before—I am talking about we, being inside the program—had picked up concerns about both the management structure and division of work and the interface complexities that that structure that you just held up alludes to, and we were working on analyzing potential variations of that to relieve the concern about the accountability and indefinite aspects of basic outfitting versus finished final outfitting, when General Phillips arrived on the scene to help us out.

I don't think—and that is a long answer—I don't think as a program manager, had he not shown up, that we would have come down exactly status quo, because of those concerns that we had already picked up as part of our phase B experience.

Mr. STOFAN. I think one other thing to understand, that there was not going, before General Phillips came in, there was a not clear line in the sand at all. The phase B work packages were defined with, in some instances, quite large overlaps in responsibility between contractors and between centers. That is why Sam was saying that you had to do something, you could not go into C/D and have these areas of overlap where people didn't know what they were supposed to bid on.

So, you had to clean up the entire process. We were doing that when he came to look at it and said, OK. I will recommend because of the management principle to go this way. That is why something had to be done. We could not have proceeded the way we were going.

Mr. BARTON. Was there another alternative—we had interrupted you there, you had discussed——

General PHILLIPS. I had discussed two alternatives. I think those are the principal ones.

Mr. BARTON. OK; is the first alternative that you discussed building a Hab module from scratch, in my terminology, would that be the same as moving the module package that is currently at Huntsville to Houston? Is that the same?

General PHILLIPS. No.

Mr. BARTON. No; so that is a third alternative then?

Your basic recommendation was to move what is in Houston to Huntsville. The reverse of that would—in order for management simplicity and contract accountability, without regard to the fixed costs that Huntsville has, would be to reverse that decision and move what is in Huntsville to Houston?

General PHILLIPS. That is certainly something that you could do; yes.

Mr. BARTON. But now you have admitted, General, that you did not cost analyze, so it is a little bit presumptuous to sit there and just say that is something that you could do, when you have admitted yourself that none of your decisions and recommendations were based on any cost analysis.

General PHILLIPS. They were not based on a detailed cost analysis; that is correct.

Dr. FLETCHER. Generally speaking, Mr. Barton, you have to make some judgmental decisions based on experience—I defy anybody in this room to indicate that they have had more experience than

General Phillips has had in program management—and then you see what the costs are. Now, if you see that the costs are more than you had figured, then you have got to ask yourself, isn't there a better way to manage that.

Mr. BARTON. I accept that General Phillips, and everyone of you gentlemen, have excellent judgment. But I do not accept that your judgment is of such a nature that you have no need for cost analysis. Even in a rudimentary decision of this magnitude, there should be an attempt made to do a cost analysis.

I don't want to belabor that, but that is—to me that is good, not only Texas common sense, but the gentleman from Alabama was asking some of the very similar questions that I was asking about cost.

I want to go on—I know there are other members. I have got just a few final questions.

As a result of all of the hullabaloo that we have had in the last 2 to 3 weeks, and as a result of this hearing—we are going to eventually get this hearing, hopefully, in the next 30 minutes or 45 minutes—Dr. Fletcher, what are you going to do? What is your next step?

Are you going to walk out of the room and say, well, boys, we toughed out, we didn't tell them anything that we didn't want them to know, and we are just going to hang in there for 90 days and then do what we want to do?

Are you going to go back and do some internal cost analysis? Are you going to review some of these 36 recommendations that General Phillips has recommended and you have accepted? The ball is going to be back in your court.

You heard what the chairman asked. He says don't go back and not come and see us; go do something and come back to us.

So my question to you, sir, with all respect, what are you going to do?

Dr. FLETCHER. With all respect, we would like to repeat what we said earlier. We are going to ask Mr. Stofan to take a look at all aspects of the program, and not only the work packages but the configuration, the design, the impact on operations; how we are going to put it together; how to minimize the EVA's, which people are concerned with; how to minimize the number of shuttle launches—all of that; plus we will even take another look at the management questions, because I am not sure we have the exact management situation that we need to go ahead with phase C/D.

But before that, I must say my first primary goal—my primary goal—is to get the $531 million back that the Defense Department took away from us. We can't go ahead without that money.

Mr. BARTON. Are you going to do a little cost analysis?

Dr. FLETCHER. On the Defense Department, you mean?

Mr. BARTON. No, sir; on the Space Station Program and all these recommendations.

Dr. FLETCHER. I will defer to Andy Stofan. But I think that is premature at this point to make—we could maybe make a cost differential analysis. In other words, how much do we save by the proposed program management that Sam Phillips suggested. But that is history. We are taking another look, and the configuration may not turn out to be the same.

So, we may—I don't know what you have in mind, but if you want us to analyze all possible options for the configuration and what our best estimate of the cost of each of those and various work packages, that is quite a task—especially since we are really depending on the contractors to provide those cost estimates for us.

Mr. BARTON. Well, if you want what I think a cost analysis would be, I would—you certainly have some estimate of what your costs are expected to be if you make no changes. I mean, you have shown us that you can at least give us a definition of manpower levels. You can give us a definition of work levels between the centers.

Mr. Stofan had that in his testimony. So, you have got some rudimentary cost system in place. So we ought to have a baseline cost that we can go from; you have got General Phillips' recommendations which you accepted at one point in time. You could do what I would call when I was an engineer at A&M, a gap analysis, compare where you are today, where those changes take you, and what the cost involved is in that, including structural changes, transferring of people, capital investment, and then either extra costs or additional savings for making those changes. That is the way I would do it. But then, again, I am not in your shoes.

Mr. NELSON. Any other member of the committee or Members of Congress participating with us like to have any further discussion?

Mr. Andrews.

Mr. ANDREWS. I just want to clear one thing in my mind.

I, like my colleague, Mr. Chapman, I guess, misheard what you said earlier today, or collectively I thought I was hearing between the lines that this 90-day period was going to be very costly for the program. Do I understand now that the 90-day cooling period—reassessment period—is not going to cost any money, in terms of dollars? I just want to be clear that I understand——

Dr. FLETCHER. Neither statement is true.

I think somebody asked me earlier how much we had saved by the decision to go with the work package that General Phillips recommended, and I said the savings in that decision were much larger than any cost involved in the standdown period.

I don't know what the cost of the standdown period would be; it is appreciable, but not anywhere near as much savings by an efficient program management.

Mr. ANDREWS. Let me be sure I understand. One of the things that is now being considered is a reconfiguration of the station itself; is that correct?

Dr. FLETCHER. I think, certainly, that is one consideration. But also, how it is assembled is an important consideration, and that is what John Aaron was describing earlier.

Mr. ANDREWS. In other words, those fairly fundamental kind of decisions—what it is going to look like—have really not been decided yet?

Mr. Stofan, in your mind, where are you? What is your thinking——

Mr. STOFAN. Where we are—you remember there has been a year and a half of definition put into this configuration; therefore, it comes from a very strong background of having an awful lot of

analysis and look at, so we felt, we were fairly confident with the overall configuration.

Now, there are a set of concerns that have been forwarded to us recently, the last few months, which we were working. Those concerns we have to work out.

Now, they potentially could make us change the configuration. However, at this point, that may be as simple as an assembly sequence with some very minor design mods. The other end of the spectrum is a complete design change, which I think is highly improbable, but not impossible.

So, I think that the work we have done on that has, I think, confirmed that that is a pretty good thing to go ahead with. If we find something totally different in this study, and it really surprises us, well, then we will respond to it. But I would be surprised if we had to do anything that drastic.

Mr. ANDREWS. Mr. Chairman, I have got several more questions, and I know that other members of the committee do as well. The hour is late; we have been at it now for almost 5 hours.

I would like to have the opportunity, as I am sure other members would, to submit some written questions to follow up the questions and responses that we have heard today, and request that NASA reply back to those written questions and have them made a part of this record.

Mr. NELSON. Without objection.

Let me see if I can summarize here.

Of all the testimony today, with regard to questioning on both sides of this issue, on the specific question of the Houston and Huntsville issue, I have heard nothing here today that has indicated that you, individually, or collectively, have changed the decision that was initially made; is that correct?

Dr. FLETCHER. Well, we are not changing the decision because we may come up with a different design. I don't want to go on record as saying we are changing or not changing the decision on that old design.

Mr. NELSON. I understand that. I am not talking about the design. I am talking about the question of the habitability module and its stuffing, whether it is going to be—which is why we have so many members here today—in Huntsville or Houston; is that correct, that there is nothing indicated in your testimony that there is any indication at this point to change that decision?

Dr. FLETCHER. I would rather say it a little different, Mr. Chairman. I would rather say that under the configuration that was baselined as of June 30, it does seem like the most efficient program, the one that would save the most money, even though we haven't costed it out, Mr. Barton, would be the recommendation for work packages presented by Sam Phillips.

But we may not come up with that same design and that same sequence, or even that same configuration. How much of a change, as Mr. Stofan said, will have to follow in the next few days.

Mr. NELSON. OK.

Mr. Flippo, I want yours and Mr. Andrews attention on this, for all of you, because I have got a couple more followup questions.

With regard to the reconfiguration that you are going to consider, presumably when you made your statement that you would

standdown for 90 days, was that reconsideration of that potential reconfiguration going to occur within that 90-day period?

Dr. FLETCHER. Yes, Mr. Chairman. Remember I said earlier that it was important, not just for a cooling off and so that we could settle down on some numbers, but we had a number of concerns of our own. It was for both of those concerns having to do with design and assembly, it was for both of those reasons that I agreed to standdown for 90 days.

Mr. NELSON. Is it possible, in your opinon, today, that it is in the best interest of the program that we not delay in a standdown for 90 days, and make that judgment earlier than 90 days?

Dr. FLETCHER. I think all of us would hope that it could be made much earlier than that. I have no idea how long it will take. We have various degrees of optimism in the group that is doing the review.

If I am optimist, I would say it could happen in 30 to 60 days; if I am a pessimist, it might even go beyond the 90 days; but we committed to standdown for up to 90 days.

Mr. NELSON. Well, why don't we just conclude right here that we are going to try, since we all are saying that it would be better if we can before 90 days, why we just conclude right here, let's shoot for that as a target, less than 90 days, 30 to 60 days.

All right, when did the days start ticking; what was the day?

Dr. FLETCHER. I think in all fairness it must have started the day Senator Gramm and Senator Garn and I stood up, that was last Thursday, I have forgotten the date.

Oh, that was the 31st of July.

Mr. NELSON. OK, 60 days would be the 31st or the 30th of September. Thirty days would be the end of August.

So between August and the end of September, why don't we expect a report from you all to this committee; we will convene this committee, at such time that you have the report and you can so deliberate with us; is that fair enough?

Dr. FLETCHER. We will make a best effort, Mr. Chairman. We will appear before you with whatever we have at that time, and I hope that we have finished the design by then.

Mr. FLIPPO. Will the distinguished chair yield?

Mr. NELSON. Mr. Flippo?

Mr. FLIPPO. How long have we been designing this space station, how many years have we been designing this space station?

Dr. FLETCHER. It depends on what you count, Mr. Flippo.

Mr. FLIPPO. When did it start——

Dr. FLETCHER. I think vigorously, probably, we started when the President made his announcement in January 1984. But, of course, as you know, many designs, including one, by the way, that I was involved in in 1981, were studied over the years.

Mr. FLIPPO. So you figure, then, that we can redesign this thing in about 30 to 60 days——

Dr. FLETCHER. If it is a major redesign, it would take longer that; if it is a small redesign, as we are all hoping for, maybe we can do it in 60 days.

Mr. FLIPPO. Thank you.

Mr. NELSON. Mr. Andrews?

Mr. ANDREWS. One more thing. I have an economic impact of the space station work transfers that was prepared by the University of Houston, at Clear Lake, and for the benefit of the committee in this debate, I would like unanimous consent to add this to the record.

Mr. NELSON. The chair is welcome to receive any and all information as long it has the most strained contact with the subject at hand; I am delighted to have it; and it will become a part of the record.

[The report—appendix A—follows:]

APPENDIX A

THE ECONOMIC IMPACT OF SPACE STATION WORK TRANSFERS FY 87-93

Prepared by

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July 21, 1986

ECONOMIC IMPACT OF

SPACE STATION WORK TRANSFERS

FY 87-93

Summary

Total Dollar Impact	$1,500 Million
Total Manpower Impact	3,100 Man Years

Source: Bureau of Research, UH-Clear Lake

Assumptions:

1. JSC data used as a departure point.
2. Relevant economic parameters and methodology applied to model.
3. No assessment of additional corporate resource or investment reallocations made.
4. All data in 1987 dollars and no value of time assessment made.

DETAIL

ECONOMIC IMPACT OF

SPACE STATION WORK TRANSFERS

FY 87-93

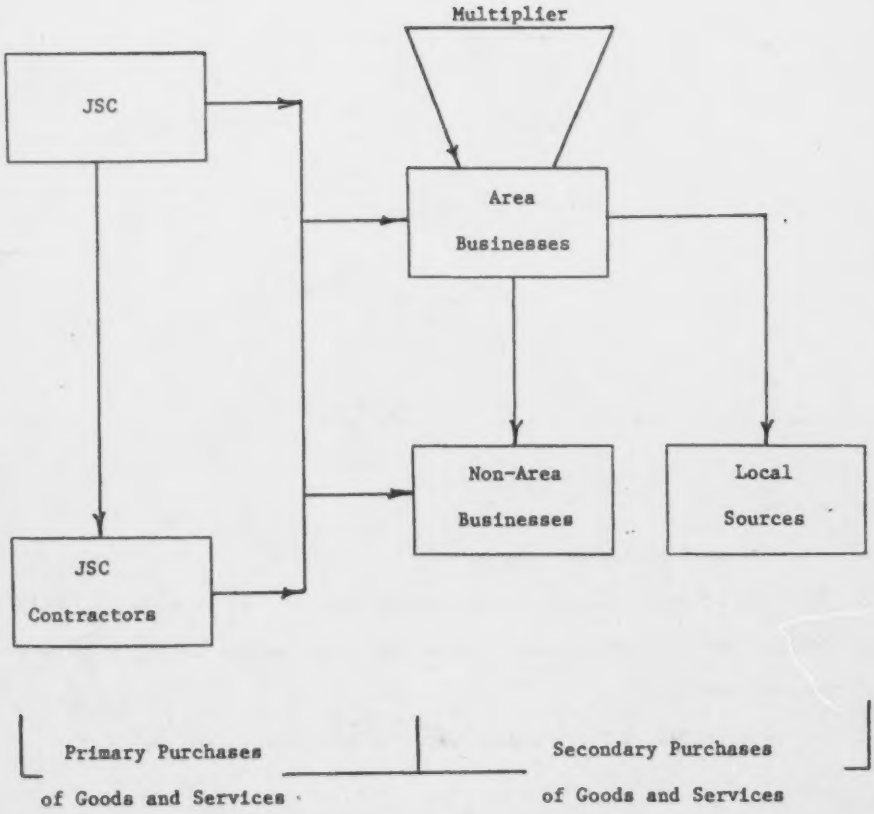
	Dollar Impact	Manpower Impact
Direct	$ 1,100 Million	1,900 Man Years
Indirect	400 Million	1,200 Man Years

Source: Bureau of Research, UH-Clear Lake

Assumptions:

1. JSC data used as a departure point.
2. Relevant economic parameters and methodology applied to model.
3. No assessment of additional corporate resource or investment reallocations made.
4. All data in 1987 dollars and no value of time assessment made.

METHODOLOGY IN SCHEMATIC FORM



Source: Bureau of Research, UH-Clear Lake

BASIC CALCULATIONS

Direct Dollar Impact

Sum of the annual work package dollar differentials = $1,100 million.

Direct Employment Impact

Peak work package dollar differential/dollars per man year = 1,900 man years.

Indirect Dollar Impact*

Sum of area expenditure impacts from JSC employees, contractor employees, locally purchased inventory and multiplier effects = $400 million.

Indirect Employment Impact

Area dollar expenditure volume X man years per million dollars = 1,200 man years.

* See detail on next page.

Source: Bureau of Research, UH-Clear Lake

DETAIL OF CALCULATIONS

FOR INDIRECT IMPACT*

Primary Expenditure Cycle

$\triangle$Total JSC Related Expenditures = $\triangle$JSC and Contractor Expenditures + $\triangle$Employee Expenditures in Area.

$\triangle$JSC and Contractor Expenditures = $\triangle$[JSC Funding - Payroll]

$\triangle$Employee Expenditures in Area = ($\triangle$Payroll) (Parameter1)

Secondary Expenditure Cycle

$\triangle$Total Business Volume Impact = $\triangle$Total JSC Related Expenditures + $\triangle$Area Business Inventory + Successive Area Expenditures.

$\triangle$Area Business Inventory = ($\triangle$JSC Related Expenditures) (Multiplier1)

$\triangle$Successive Area Expenditures = ($\triangle$JSC Related Expenditures) (Multiplier2)

Area Job (Man Year) Impact

$\triangle$Man Years = ($\triangle$Total Business Volume Impact)(Parameter2)

* All expressions are simplified for presentation to suggest the essence of the process.

Source: Bureau of Research, UH-Clear Lake

INVESTMENT AND RESOURCE ALLOCATION IMPACT

Corporate-level decisions to reallocate resources and to alter investment patterns rest on several and varied criteria. Given planning horizons, mobility factors, and expectations as weighed against alternative plans of action, it is reasonable to expect some change in both the timing and the dollar value of area economic development if the space station work package transfer plans remain in place. While the magnitude of this impact is difficult to quantify, it is closely related to current economic momentum in the area and expectations of the future.

Between 1980 and 1985 JSC related business volume in the area economy grew by 50 percent (8.7 percent per year). JSC also commands the largest employment source in the area. Interruptions in the established steady growth patterns have the potential to alter both near term and long term contractor location decisions, the rate and character of commercial development, and the general viability of the area economy.

Source: Bureau of Research, UH-Clear Lake

THE IMPACT OF THE NASA JOHNSON SPACE CENTER ON THE CLEAR LAKE AND GREATER HOUSTON AREA ECONOMY, 1980-85

by

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and

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THE IMPACT OF THE NASA JOHNSON SPACE CENTER ON THE CLEAR LAKE AND GREATER HOUSTON AREA ECONOMY, 1980-85[1]

INTRODUCTION

With a projected economic impact of nearly $1 billion fostering 28,000 jobs in 1986, NASA's Johnson Space Center (JSC) is a key enterprise in the greater Houston area economy. This study uses a unique modification of an established methodology to measure the overall economic impact of one of NASA's largest space centers—JSC, located in southeast Houston. The methodology captures the impact of current expenditure flows from all major sources as well as resulting multiplier effects. Indirect effects of technological spin-offs are also discussed.

BACKGROUND

In 1962, NASA selected the Clear Lake area, 23 miles southeast of Houston, Texas, as the location for the Manned Spacecraft Center. Renamed the Lyndon B. Johnson Space Center in August 1973, the center has primary responsibility for control, subsequent to lift-off, for all NASA manned space flights. In addition, JSC has the lead role for the intercenter management and integration of the NASA manned space programs.

During the twenty-five year history of JSC the economic impact on the Clear Lake area and, to a lesser extent, the greater Houston area economy has been dramatic. A 1980 study, which assesses the economic

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[1]The authors are Assistant Professors of Finance at the University of Houston-Clear Lake. They wish to recognize the aid and advice of E.E. Liebhafsky in earlier drafts of the work.

2

impact of JSC during the 1978-79 period, provided valuable insights relative to the early economic impact of the space flight programs.[2] Prior to and during that time, however, manned space flights utilized non-reusable boosters which necessarily maintained, at a high level, the cost per pound of putting payloads in space. NASA has long recognized the need to reduce the cost of placing payloads in orbit and is achieving that essential reduction via the space shuttle orbiter vehicle, utilizing reusable solid rocket boosters which are recovered and refurbished after each launch. Equally important, the reduced cost of putting payloads in orbit is providing an incentive for the entry of numerous firms onto into the commercial space industry Specifically, companies are opening new offices in the Clear Lake Area to gain access to this commercial gateway to space.

The softness of the oil-based Houston area economy, contrasted with the relatively prosperous Clear Lake Area economy, presents an interesting dichotomy. Greater Houston area business leaders are well aware of this as evidenced by their overt attempts to exploit the economic opportunities and benefits of space commercialization. The desire for a firmer coupling of the Clear Lake-Greater Houston area economies is illustrated by the recent appointment of the immediate past director of the Johnson Space Center, as President of the Houston Chamber of Commerce. That individual, Gerald Griffin, has made clear his intentions to utilize the space industry as a primary focus in diversifying the greater Houston economy.

This paper constitutes a first step toward examination of the impact of the Space Shuttle Program on the Houston Economy and suggests possible space commercialization enhancements of the Greater Houston and Clear Lake economies.

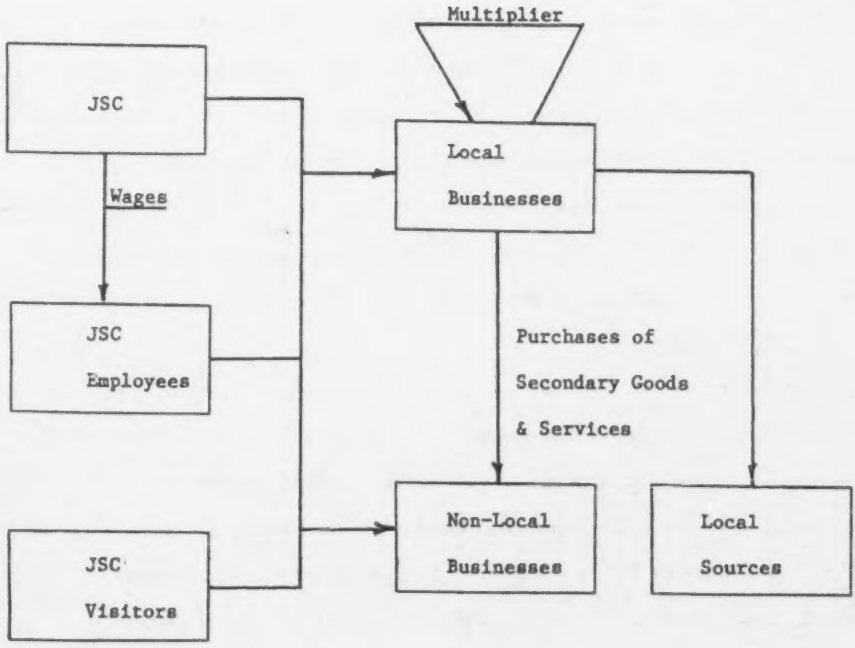
METHODOLOGY

This study focuses on the through-time flows of current expenditures for the period 1980 - 1985 by JSC, its employees, JSC support contractors, and JSC visitors. These direct dollar flows spawn other indirect expenditures and support additional employment in the greater Houston area. The model assesses only the private market expenditure and employment impacts of dollars flowing into the Clear Lake-Greater Houston area economy due to NASA's JSC. It captures primary and secondary influences, but does not attemt to assess the economic impact of investment in new or expanded physical plant or equipment. (See Figure 1).

Four equations comprise the bulk of the model's structure.[3] Each of the four related equations has one or more variables and parameters which are measured or estimated on an annual basis.[4] Where parameters could assume more than one value, the most conservative value was chosen. Final dollar flow estimates and employment data are conservatively stated, resulting in a realistic annual estimate of dollar flows and their impact.

FIGURE 1

Schematic of the Model



Equation 1 in the model assesses the area business volume related to JSC activities. Equation 2 measures the non-market expenditures due to the existence of JSC enterprises, notably the visitor center and cafeteria. Equation 3 estimates the number of area jobs attributable to the presence of JSC. Finally, equation 4 provides the area personal income generated from JSC jobs and business activities.

DIRECT ECONOMIC IMPACT

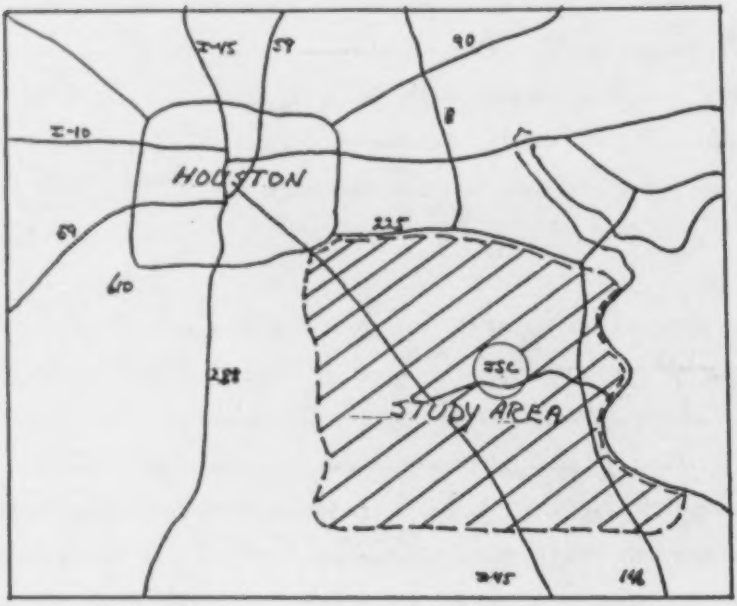
The combined results of the equations provide a reasonably precise assessment of the direct economic impact of JSC's activities on the area. As shown in Table 1 annual estimates for the economic impact of JSC, measured in nominal dollars, show that area business volume grew by approximately 50 percent (8.7% per year) between 1980 and 1985. The figures represent the purchases of area goods and services by JSC; wages paid to JSC employees; subsequent expenditures by JSC employees in the area; wages paid to JSC contractor employees; subsequent expenditures by those contractor employees; expenditures by non-area visitors; and multiplier effects via respending from all sources.

"Non-market expenditures" represent spending primarily by tourists visiting at JSC. In 1985, for example, approximately $3 million was spent in enterprises such as souvenir gift shops and cafeteria. Hence, these expenditures did not flow into the local economy.

The area employment estimates for each year include the permanent employees at JSC, contractor support personnel, and the number of jobs generated by the direct JSC related expenditure flows. In 1985, JSC employed 3,404 permanent employees, contractor support totaled 6,250 employees, and expenditures directly related to JSC activities supported

FIGURE 2

Geographic Region of the Study



The geographic area encompassed by the study is roughly rectangular in shape and runs from Dickinson Bayou on the south to northern Pasadena on the north and is bounded by Galveston Bay on the east and Brazoria County on the West.

another 18,303 jobs in the greater Houston area. Between 1980 and 1985, area employment attributable to JSC's economic flows increased approximately 28 percent (5.1% per year).

In 1985 personal income in excess of $427,000,000 was generated by direct JSC activities for Clear Lake and greater Houston area workers.

The magnitude of JSC's impact on the greater Houston economy can best be assessed by comparison with that of some of the city's larger firms, providing a relative dimension to the annual economic thrusts provided by the space center's activity. The 1984 revenues earned by Compaq Computer ($325,013,000), CRS Sirrine ($306,316,000) and Allied Bancshares ($260,781,000) would need to be aggregated to surpass the economic impact of JSC in any year since 1983. As previously stated, the JSC installation rests in the heart of what is known as the Clear Lake Area, located in the southeast section of Houston. Although the economic impact of JSC activities extends well beyond the boundaries of the Clear Lake area, some local comparisons are still useful. In 1984, for example, JSC dollar flows supported approximately 27,800 jobs in the greater Houston area. Total estimated employment for all industries in the Clear Lake area in 1984 (the latest available data) was only 55,000 jobs.

Projections for 1986, based on the prior five years annual average growth rate, appear in Table 2.

TABLE 1

JSC Economic Impact on the Bay Area

1980-1985

Year	Area Business Volume	Non-Market Expenditures	Area Employment	Area Personal Income
1980	$ 559,709,000	$ 2,925,000	21,700	$ 296,417,000
1981	598,622,000	3,500,000	22,834	318,187,000
1982	741,880,000	3,250,000	25,362	370,831,000
1983	859,216,000	3,000,000	27,712	415,768,000
1984	837,418,000	3,000,000	27,249	409,287,000
1985	850,011,000	3,000,000	27,937	427,703,000

TABLE 2

Projected JSC Economic Impact on the Bay Area*

Year	Area Business Volume	Area Employment	Area Personal Income
1986	$ 925,000,000	29,400	$ 460,000,000

* These projections assume no significant budget reductions and no major changes in national priorities.

TECHNOLOGICAL SPINOFFS

In addition to the direct and indirect benefits quantified above, there are numerous technological spinoffs which have the potential for equal or greater economic impact. The commercial spinoffs discribed below resulted from technology developed at JSC.[5]

I. HEART MONITOR - This device is a portable, computerized cardiac system that offers phyicians a new approach to monitoring ambulatory patients with coronary artery disease. The cardiac monitor alerts the patient to impending high-risk cardiac events by continuously evaluating the electrocardiographic signals generated by the heart. The heart monitor, which incorporates NASA technology, is the product of three years of research and development and would appear to have potential world-wide benefit.

II. VEHICLE CONTROLLER - For the Apollo lunar landings of the early 1980s, NASA developed a Lunar Rover to permit exploration of the moon, miles from the immediate vicinity of the landing site. The Rover was designed to allow an astronaut to drive one-handed, using an airplane-like joystick to accelerate, brake, and steer the vehicle. That technology is being applied to a system that offers severly handicapped people an opportunity to drive hignway vehicles, providing them mobility for more productive lives.

III. ANTI-FOG COMPOUND - This is an inexpensive preparation that prevents condensation of moisture on plastic and glass without harming the surfaces of such materials. Among its possible applications is fog prevention for eyeglasses, ski goggles, skindiving masks, car windows, bathroom mirrors, camera lenses, and helmet face shields worn by firefighters or motorcyclists.

The compound was originally developed by Johnson Space Center (JSC) to bar fog formation on astronaut helmet visors and spacecraft windows. The basic composition includes a liquid detergent, deionized water and an oxygen-compatible fire resistant oil.

SUMMARY AND CONCLUSIONS

NASA's Johnson Space Center is a dynamic economic hub in southeast Houston. This study has estimated the size of JSC's private market impact on the Clear Lake and Greater Houston economies in terms of total business volume, employment, and personal income. The methodology permitted all major dollar flows to be accounted for and estimation of multiplier effects from respending in the area. Projected figures for 1986 indicate a total economic impact of nearly $1 billion fostering some 28,000 jobs. The role of technological spinoffs was also addressed, citing several specific examples. Findings of this study could be used by public policy decision makers to review the impact of large dollar flow changes in the Clear Lake area and Greater Houston economy. This same methodology could be used to provide valuable estimates of the impact of dollar flows accompanying NASA's Space Station Program.

NOTES

1. A significant portion of the data collection and analysis for this paper was completed prior to the shuttle explosion on January 27, 1986. Consequently, the conclusions and potential applications of the study could be significanlty affected by actions of the federal government and NASA concerning priorities and funding. The authors recognize that complete and final resolution of uncertainties resulting from the shuttle accident may not be known for some time. This paper offers a starting point for economic impact assessments.

2. Rodrigues, Louis J. and Roberto Marchesini, "Impact of the NASA Johnson Space Center on the Houston Area Economy," Texas Business Review, November - December, 1980.

3. Caffrey, John and Herbert Isaacs, Estimating the Impact of a College or University on the Local Economy, Washington, D.C.: American Council on Education, 1971. The methodology applied in this study draws liberally from the framework originally designed by Caffrey and Isaacs in their work to assess the impact of a college on the local community. Transferring their approach to a government entity such as NASA's JSC is accomplished with some adjustments which do not impair applicability.

4. Data were gathered from the following sources: Fiscal Year Annual Procurement Reports for 1980, 81, 82, 83, 84, and 85, Houston, Texas: NASA Johnson Space Center; CPI Detailed Report, Bureau of Labor Statistics, Washington, D.C.; U.S. Government Printing Office, June, 1983; The Book of Lists, Houston Business Journal, 1985.

5. Spin-off 1985, Washington, D.C.: U.S. Government Printing Office, August, 1985.

APPENDIX

I. Equation 1 - An Estimate of JSC Motivated Local Business Volume.

A. Three Major Components (V)

1. JSC related Local Expenditures (C_j)

2. Local Purchases by Local Businesses in Support of Their JSC Related Business Volume (C_b)

3. Local Business Volume Generated by JSC Related Income Other Than JSC Employee Expenditures (C_v)

B. C_j, Major Components

1. Local Expenditures by JSC (C_{j1})

a. Percent of Local Expenditures (S_{j1})

b. JSC Total Budget (B)

c. JSC Payroll (P)

d. Transfers (TR)

2. Local Expenditures by JSC Employees (C_{e1})

a. Local Non-Housing Expenditures $(C_{e1})_d$

b. Non-local Non-Housing Expenditures $(C_{en1})_d$

3. Local Expenditures by JSC Visitors (C_{v1})

II. Equation 2 - An Estimate of Non-market Expenditures by Tourists Due to JSC Enterprises.

III. Equation 3 - An Estimate of the Number of Local Jobs Attributable to the Presence of JSC (L)

A. JSC Employees (E_j)

B. JSC Contractor Support (E_c)

C. Estimate of Area Jobs Generated From JSC Expenditure Flows (E')

IV. Equation 4 - An Estimate of Personal Income of Local Individuals from JSC Related Business Activities

V. Example Equations and Figures in the Model

A. Equation 1

$$V = C_j + C_b + C_v$$

$$= (C_{jl} + C_{el} + C_{vl}) + C_b + C_v$$

$$= [(S_{jl})(B-P-TR)] + [(C_{el})_d + (C_{enl})_d] + [(V_i)(C_{vi})]$$

$$+[(S_b)(C_j)] + [(S_l)(C_j)]$$

for 1985 the values are

$$= [(.24)(1,1862,001,000 - 155,538,000 - 7,635,958)] - [(14,760,645 + 525,918)] + [(1,353,095 \times 46.35)] + [(.15)(485,721,000)] + [(.6)(485,721,000)]$$

$$= \$850,011,000$$

where

S_{jl} = proportion of JSC expenditures (excluding compensation and transfers) that are local.

V = Total Business Volume Due to JSC

B = Total JSC Budget

P = Total JSC Payroll

TR = Internal Transfers

$(C_{el})_d$ = Local Non-housing Expenditures by Local JSC Employees

$(C_{enl})_d$ = Local Non-housing Expenditures by Non-local JSC Employees

V_i = Number of visitors to JSC

C_{vi} = Expenditures Per Visitor at JSC

S_b = Proportion of Local Business Purchases From Other Local Businesses

C_j = JSC Related Local Expenditures

S_1 = Individual Income Local Respending Coefficient

B. Equation 2

$V_u = I'$

= $3,000,000 (Estimated from JSC information).

V_u = Non-market Expenditures by Tourists Due to the Presence of JSC

I' = Income from JSC Visitor Center and Cafeteria Sales

C. Equation 3

$L = E_J + E_c + (S)(C_j')$

$= (3404) + (6250) + (.00007)\ (261,474,000)$

= 27,957

where

L = Total Area Employment Due to JSC

E_J = Total Permanent JSC Employees

E_c = Estimated JSC Contractor Support

S = Full Time Jobs Per Dollar of Direct Expenditures in the Local Economy

C_j' = JSC Related Local Expenditures Modified to Reflect Contractor Payroll

D. Equation 4

$I = f_1(P) + (S')C_j$

$= (.9)(155,538,931) + (.58)(485,721,000)$

= $427,703,000

where

I = Personal Income of Local Individuals From JSC Related Jobs and Local Expenditures

f_1 = Proportion of JSC employees Residing Locally

P = JSC Payroll

S' = Payrolls and Profits per Dollar of Local Direct Expenditures

C_j = JSC Related Local Expenditures

Mr. NELSON. Now, back in 1984, in December of 1984, there was a space station management plan and procurement strategy, one of the recommendations was, now I quote from page 311, 3-11: "To avoid having this long-term space resource become captive to a particular contractor, to serve as a means of sustaining the in-house NASA civil service capabilities for SE&I, systems engineering and integration, and to assure that NASA remains a smart buyer, the decision has been made to conduct the space station program without using a prime contractor for the program SE&I."

And then in this same announcement on June 30th, Dr. Fletcher, you announced that NASA would contract out the systems engineering and integration, contrary to what had been recommended previously. Please share with us your thinking there.

Dr. FLETCHER. Well, I think the first recommendation is that we don't go with the prime contractor to do all the work and the SE&I. The second recommendation is, which followed much later, is that yes, indeed, we support that first recommendation, we won't go to one contractor that does all the work plus the SE&I. What we will do is go for, I guess, at least, four, probably, six contractors. One of which will do the systems engineering but not the "I" the integration will still be done by Johnson Space Center.

Mr. NELSON. So you will have four doing this systems engineering and integration?

Dr. FLETCHER. No; four doing the hardware, and then one doing probably what we call TMIS that is the management information system, and then another one helping with the systems engineering function, but not the integration function.

Mr. NELSON. Not the integration?

Dr. FLETCHER. The integration function, Mr. Chairman, is still at Houston, there has been no change so far in that decision.

Mr. NELSON. OK, for the record I just want to clarify what you are saying is that there has been nothing in your corporate thinking that has changed since this report that says that you want to keep this function in-house; is that correct?

Dr. FLETCHER. I think it is correct, although I wasn't there, Mr. Stofan was present when that document was made.

Mr. STOFAN. The key word there was prime. In the beginning we decided we did not want to go to a prime contractor, that is one person in charge of everything, and that is what they mean by prime.

Mr. NELSON. It didn't say, prime; it said, particular. It said, "wanted to avoid becoming captive to a particular contractor," I am using the words of the report.

Mr. STOFAN. It is the same thing, that is what we call a prime, a single contractor.

Mr. NELSON. "And to serve as a means of sustaining in-house, civil service capabilities for SE&I."

Mr. STOFAN. Yes; and when that decision, recommendation, decisions were made, it was recognized at that time that if NASA decided to do the SE&I function that we would need the help of a support service contractor because we did not have all of the talents, nor the number of people to carry out that function, and this was recognized from the beginning. I think that is consistent with what we are doing today.

Mr. NELSON. General Phillips, was that the way that it was done on Apollo?

General PHILLIPS. I don't understand the question; was what the way it was done on the Apollo?

Mr. NELSON. How was the systems engineering and integration function handled; was it handled by a contractor; was it handled in-house by NASA's civil service capabilities; or was it a combination thereof?

General PHILLIPS. It was a combination thereof. In the Apollo Program we had early in the program, a support contractor, supporting us here in Washington, it was a company called Belcom, that did top-level systems engineering and analysis. Later in the program we contracted with the Boeing Co. to provide a technical integration and evaluation function and they had a significant number of people here in Washington, and also, at the principal centers. Each center, Johnson, then called the Manned Spacecraft Center, and Marshall, had significant numbers of civil service people doing system engineering functions and they in turn were supported by both their industrial contractors and by support contractors in the engineering and integration functions. So, it was a combination of civil service, major industrial contractors, and support contractors.

Mr. NELSON. OK; thank you very much for that information.

Any other questions?

OK, gentlemen, thank you for you indulgence. We will look forward to receiving your report in what we expect to be September.

The meeting is adjourned.

[Whereupon, at 5:50 p.m., the hearing adjourned.]

SPACE STATION MANAGEMENT

THURSDAY, SEPTEMBER 25, 1986

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS,
Washington, DC.

The subcommittee met, pursuant to call, at 1:08 p.m., in room 2318, Rayburn House Office Building, Hon. Bill Nelson (chairman of the subcommittee) presiding.

Mr. NELSON. Good afternoon. The subcommittee will come to order.

Today, we are holding oversight hearings on a matter that has been of considerable importance to this subcommittee. We will examine the progress that NASA has made in reviewing the space station management plan and the hardware baseline.

Last August 5, we held hearings on NASA's announced plans to realign the space station work packages. It is fair to say that this announcement and its implications were questioned by this subcommittee. We were not satisfied at that time, and we have asked NASA to revisit the issue.

Specifically, we asked NASA to justify any final management decisions in terms of cost, management factors, and effects on the various NASA centers' roles and to ensure that all alternatives were fully explored.

Another parallel issue which emerged at that time was the feasibility of the baseline configuration. We became aware of the concerns of some of the astronauts over the amount of EVA time that would be required to construct the station. In addition, we wanted to be sure that the assembly scenario that NASA will ultimately decide on is consistent with the capabilities and the availability of the shuttle fleet in the mid-1990's.

So we asked NASA to report back to us on these items for today's hearings, so that we could assure the facts are there that adequate progress has been made prior to our planned adjournment in just a week or two. And it is anybody's guess at this point what that adjournment date is going to be.

We are fully aware that NASA has worked hard on its commitment, putting in some very long hours over the last month, particularly at the Langley Research Center as well as the midnight oil being burned in your office, Mr. Stofan. The urgency of resolving these issues at this critical time in the program certainly has demanded such an effort, and you have given very strong leadership to that, Mr. Stofan. We commend you for that.

It goes without saying that we on this subcommittee strongly support the space station. As you know, we have the NASA authorization bill on the floor. We did the general debate last night. We will pass the bill probably after the continuing resolution is considered late this afternoon. And in that NASA authorization bill you know that this committee has come forth supporting your recommendation to the Congress of $410 million for the space station for fiscal year 1987. Now we want NASA to proceed expeditiously with issuing the request for proposals based on a clear concept of what we will build, how we will build it, and how we will manage it. And so we are looking forward to having NASA answer this challenge. So today we are going to hear from the Administrator, Dr. Fletcher, and Mr. Stofan.

We look forward to your testimony.

Mr. Lujan, do you have an opening statement?

Mr. LUJAN. No; Mr. Chairman, I don't have an opening statement. I just want to welcome both of our witnesses today, and look forward to seeing where we are going from here.

Thank you very much, Mr. Chairman.

Mr. NELSON. All right. And we will submit for the record Mr. Walker's statement, and he will be here shortly.

Now, Mr. Andrews, I'm going to call on him because he has been summoned to the floor by the chairman of Ways and Means since the tax bill is on the floor this afternoon.

And, Mr. Andrews, you are a sight for sore eyes. Welcome back to this committee.

Mr. ANDREWS. Thank you, Mr. Chairman. There is a less important issue raging today in Congress, and that is the tax bill.

I do want to say in complimenting Mr. Stofan that I have never seen a finer model of a space station in my life. It's really terrific. With the budgetary cuts that we fear may occur, maybe we could launch the model. I'm not sure we'd fool the Soviets, but surely we'd confuse them for a few moments. It's really terrific.

I want to take the opportunity to thank Mr. Stofan for coming before our committee today, and thank him for what I think has been a healthy and somewhat vigorous debate on this issue from the early part of July until this afternoon. I think that you've done a tremendous job in trying to bring this issue to a conclusion that's in the very best interest of the Space Program. And that's true of the members of—not just people at JSC, but at Marshall as well.

What I think we cannot overlook in this debate is that we are truly in a race with the Soviet Union and we must—we must resolve this issue in a favorable way. And those of us in Congress that are going to be fighting for this space station, and those of you at NASA and the people around this country that are in favor of this country moving ahead in space, we've got to get about that business. If we're going to, first, compete and be victors over the Soviets in this important race; and, second, if we're going to expand our economic horizons which are so critical in this decade and so much more critical in coming decades, we've got to resolve this issue and push our program ahead.

I'm satisfied as a result of our briefing this last week and what I anticipate your testimony today to be that we're making great progress on this issue. And I'm very comfortable with that fact,

and I know the Texas delegation stands ready to push forward, and that's exactly what we, frankly, have always wanted to do.

I would like to take the opportunity to say to our chairman, Bill Nelson, that throughout this rather strenuous and vigorous discussion through the last several months his leadership has been extremely important in what I think will be an appropriate resolution of this whole issue. And we absolutely as a Congress must exert the strongest kind of leadership if we're going to push our Space Program forward. Not just relative to the station, but all of the other issues that are important. And we are very fortunate to have Bill Nelson as our chairman, and I sincerely believe that with Bill at the head we're going to make progress in the next Congress and some great and large advances in where we need to be if we're going to increase our lead and catch the Soviets in some of the very critical races that we're now presently involved in.

That said, thank you, Mr. Chairman. I hope I can come back to hear the rest of both of your testimonies.

Mr. NELSON. Thank you, Mr. Andrews.

Mr. Walker.

Mr. WALKER. Thank you, Mr. Chairman. I have no opening statement. I look forward to hearing from the witnesses. I think they bring to us some new concepts that will be very attractive to this committee, and I hope that it's the kind that's going to move forward faster and with a better program.

Mr. NELSON. Any other opening statements? All right.

Dr. Fletcher.

STATEMENTS OF JAMES C. FLETCHER, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, DC, AND ANDREW J. STOFAN, ASSOCIATE ADMINISTRATOR FOR OFFICE OF SPACE STATION, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, DC

Dr. FLETCHER. Mr. Chairman, we are glad to be back on schedule and give you a progress report on where we've been for the last 2 months, since we were here last August.

I would like to submit my statement for the record and sort of summarize it for you, if that is all right with you.

When I appeared before you last August, I indicated that NASA would be conducting a review of the space station design and, of course, of the space station work packages. These packages distribute project responsibility for the program among the various field installations in keeping with the center experience and the contractor accountability. Those two sometime seem to conflict, the contractor accountability and center experience. But I think as you will see Mr. Stofan has resolved that rather well.

We have now conducted much of the review, and I'm here today to provide the subcommittee a progress report. With me, of course, as already have been mentioned, is Andrew J. Stofan, Associate Administrator for the Office of Space Station, who is prepared to discuss the analysis with you in some detail.

The analysis so far has been thorough and technically sound, but I'm not yet ready to make any final decisions. We need additional

information. I believe we need a better understanding of the potential for use of ELV's—expendable launch vehicles—in the Space Station Program, particularly in the launch and assembly sequence. A more complete understanding of design modification cost impacts is now required. As you know, Tommy Newman isn't here, and he hasn't really had a chance to go over the cost impacts of the modifications.

In addition, greater specificity of the functional and organizational dimension of the space station structure within the overall management of the program is warranted. I have asked Mr. Stofan to complete this analysis and expect to begin my final review within a month or so.

The review of the space station design was conducted during August and September by a special NASA technical team with substantial assistance from the space station contractors, international partners and the users. Located nearby at the Langley Research Center, in Hampton, the critical evaluation task force—they keep calling that the CETF, and I keep forgetting what it stands for—critical evaluation task force examined the baseline configuration specifically addressing the issues of transportation capability, flight assembly and check out, operations, and safety. Special consideration was given to user accommodation and to congressional concerns, as you indicated, such as the capability for early payloads.

This group's work was reviewed by the NASA Executive Technical Committee—NETC, another acronym—a senior group of NASA technical experts from all the NASA centers both established and chaired by Mr. Stofan. The work was also reviewed by the NASA center Directors and by the committee chaired by Gen. Sam Phillips that is assisting me in an overall review of NASA management. In addition, advice was received and solicited from the space station contractors.

On September 17, which was just last week, a report on the design review was presented to me at the Langley Center. Really an amazing accomplishment, Mr. Chairman.

The space station design, as revised by the critical evaluation task force, is a modified version of the original dual-keel baseline design—the model is over there, as was indicated—that features resource nodes and a revised assembly sequence. Mr. Stofan will have more to say about those resource nodes. The design incorporates an initial power level of 37½ kilowatts; reduced shuttle flights to permanently manned capability, that is, the reduced number of shuttle flights; a relocated servicing facility for satellite repair; and room for early payloads.

The design also features less demanding requirements for EVA—remember, that was one of the concerns—and improved safe haven capability, and does not preclude an emergency rescue vehicle should one be deemed necessary.

The space station work package alignment, as you indicated, has also been the subject of extensive review. NASA center Directors and senior Space Station Program officials participated in that review. The result is a recommendation to me from the Associate Administrator for the Office of Space Station, and I am comfortable with that recommendation. It addresses the concerns raised earlier, while maintaining NASA's objectives of utilizing talent

throughout the agency where it applies and of avoiding an unhealthy dependence upon a single prime contractor. These were ground rules given to the task force.

This work package alignment would assure the Johnson Space Center's continued preeminence in the development of manned space flight systems and operations during this space station era and would make maximum use of JSC's existing facilities, organizations, and trained personnel. Likewise, the recommendations make maximum use of the substantial and unique technical and managerial experience of the Marshall Space Flight Center. There are no plans for personnel shifts between Marshall and Johnson, and the proposed work package alignments envision stability in personnel at both centers.

Mr. Chairman, I hope this review and that to be provided now by Mr. Stofan satisfies the committee's request for a report on space station activities. Much work needs to be done if we are to meet the President's goal of having a permanently manned space station operational in 1994. I believe we have most of the ingredients in hand: A strong start on the space station design; an extremely competent NASA/industry technical and management team; a solid framework for international cooperation; and both the vision and dedication that rank among the finest in this country. With your continued support and understanding, we're ready for the challenge ahead.

Now I'd like to ask Mr. Stofan to discuss the configuration and the work packages with you, after which we'll try to answer any questions that you may have. And we have some support people with us that you may want to ask questions of also.

Thank you.

[The prepared statement of Dr. Fletcher follows:]

NASA
National Aeronautics and Space Administration

Hold for Release Until
Presented by Witness

September 25, 1986

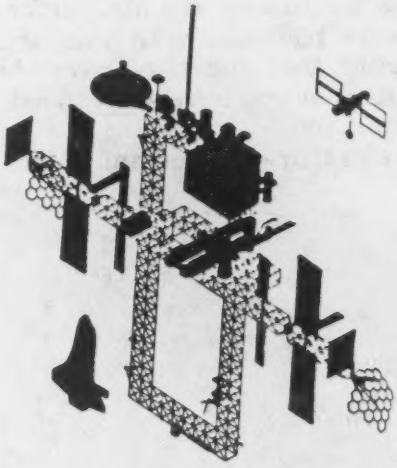
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

Statement by:

Dr. James C. Fletcher
Administrator



99th Congress

Statement of

Dr. James C. Fletcher

Administrator

National Aeronautics and Space Administration

before the

Subcommittee on Space Science and Applications
Committee on Science and Technology
House of Representatives

Mr. Chairman and distinguished Members of the Subcommittee:

I welcome the opportunity this afternoon to review the status of the Space Station program with you. Your interest and support of the program have been significant factors in the progress we have made so far. I look forward to working with you in the future, confident that the cooperation between NASA and the Congress that has characterized the space program will continue.

Let me begin by reaffirming the importance NASA and the Administration place on the Space Station. We believe the Space Station to be essential to regaining a position of leadership in space for the United States. The Station is the centerpiece of our future space program and the building block of our activities at the beginning of the 21st Century. Science and applications, technology and transportation as well as commercial space endeavors will all benefit from Space Station's unique and diverse capabilities. With a permanent presence in space, with the advantages of both human beings and automated systems, the Space Station - both the manned base and unmanned platforms - will represent a quantum leap in our ability to utilize and explore the space environment.

The Space Station is a key element in our recovery of national momentum after the loss of Challenger. As we chart and implement our near-term strategy, we must concurrently shape the future. Only the timid would focus solely on the present. The Space Station is about the future. In the year 2004 the Station will still be relatively new, with many years of productive service ahead of it. Now, more than ever, we must move the Space Station program forward so that its unparalleled potential can be realized.

As this Subcommittee knows space has become an arena of international competition. No longer does one nation dominate. Capabilities in space science, space transportation and space technology are enjoyed by many nations. Our friends in Europe and Japan have highly sophisticated and successful space programs. The Soviet Union is pursuing a large, multi-dimensional set of space activities. Technically advanced, wide in scope, the Soviet program includes a Space Station program enabling cosmonauts to live and work in space for extended periods of time. The smaller "Salyut" stations are now being replaced by the "MIR" space station. According to

the Soviets, MIR will be a permanently manned facility. Clearly the Soviets are determined to lead the world in space activities in the decade of the 1990's and beyond. I'm sure this Subcommittee shares my conviction and that of President Reagan that we have not embarked upon the Space Station program here in the United States to achieve a position of second place. The American people deserve - and will demand - something better.

When I appeared before the Subcommittee early in August I noted that NASA would be conducting a review of Space Station design and of the Space Station "work packages." These packages distribute project responsibility for the program among the various NASA field installations in keeping with Center experience and contractor accountability. We have now conducted much of that review and I am here today to provide the Subcommittee a progress report. With me is Mr. Andrew J. Stofan, Associate Administrator for Space Station who is prepared to discuss the analysis with you in some detail.

The analysis so far has been thorough and technically sound. I am not yet ready, however, to make any final decisions. Additional information is required. I believe we need a better understanding of the potential for use of expendable launch vehicles (ELV's) in the Space Station program, particularly in the launch and assembly sequence. A more complete understanding of design modification cost impacts is also required. In addition, greater specificity of the functional and organizational dimension of the Space Station headquarters structure within the overall management of the program is warranted. I have asked Mr. Stofan to complete this analysis and expect to begin my final review within a month or so.

It might be instructive, before Mr. Stofan presents the findings of his studies to date, to outline the background and objectives of the overall design review and work package analysis we have conducted.

At the conclusion of the Space Station Phase B definition stage NASA and its contractors had established a Space Station "baseline configuration." This configuration was a "Dual Keel" design. It featured twin vertical spines, linked by upper and lower cross booms and by a central transverse boom near the center of gravity supporting the manned modules as well as the large power system. This configuration nicely integrated a number of technical and programmatic considerations and was to serve as the basis for both Space Station preliminary design and the Phase C/D hardware development competition scheduled to begin in FY 1987. While satisfying a number of design requirements, the design required Shuttle performance and frequency of flight that, as a consequence of the Challenger accident, was unlikely to be met. The baseline also required extensive extravehicular activity (EVA) for both assembly and operations at a level beyond what is now considered feasible. In addition, the baseline design incorporated a "safe haven" philosophy that many felt was too optimistic.

Concurrent with the establishment of the baseline configuration, NASA had defined the Space Station work packages. We had distributed the Space Station work among the centers to capitalize on different expertise within the agency and to avoid reliance upon a single contractor for a major program expected to last for over 25 years.

Congressional concern over the implications of the work packages, combined with concerns with the baseline configuration design, led me in July to mandate the review we are now discussing.

The design review was conducted during August and September by a special NASA technical team, with substantial assistance from the Space Station contractors, international partners and the users. Located at the Langley Research Center, Hampton, Va., the "Critical Evaluation Task Force (CETF) examined the baseline configuration, specifically addressing the issues of transportation capability, flight assembly and checkout, operations and safety. Special consideration was given to user accommodations and to Congressional concerns such as the capability for early payloads.

The CETF's work was reviewed by the NASA Executive Technical Committee - a senior group of NASA technical experts from all the NASA centers, both established and chaired by Mr. Stofan. The work also was reviewed by the NASA Center Directors and by the committee chaired by General Samuel Phillips that is assisting me in an overall review of NASA management. In addition, advice was received and solicited from the Space Station contractors. On September 17, a report on the design review was presented to me at the Langley Center.

The Space Station design, as revised by the Critical Evaluation Task Force, is a modified version of the original Dual Keel baseline configuration that features "resource nodes" and a revised assembly sequence. The nodes are larger, outfitted versions of the pressurized interconnects that link the laboratory and habitat modules. These nodes will now house subsystems required for spacecraft control and will incorporate subsystems that earlier were located either outside on the structure, or were located inside the laboratory or habitat module. In the earlier configuration, these nodes were empty, used in conjunction with tunnels, to serve as passageways between the modules. The design also incorporates an initial power level of 37.5 kilowatts, reduced Shuttle flights to permanently manned capability, a relocated servicing facility (for satellite repair), and room for early payloads. The design also features less demanding requirements for EVA, an improved safe haven capability, and does not preclude an emergency rescue vehicle should one be deemed necessary.

The revised design also provides for early incorporation of Phase One of the Canadian Mobile Servicing Center, which will include Canadian remote manipulator arms which work in conjunction with a U.S. transporter. The design also includes pressurized laboratories to be provided by Europe and Japan as well as European built unmanned platforms.

Mr. Chairman, as you can see, the Space Station program has a strong international flavor. President Reagan invited friends and allies of the United States to join the endeavor and NASA and the State Department are working together on negotiations we hope will lead to agreements for hardware development and Space Station operations. Representatives of Canada, the European Space Agency and Japan participated in the design review at the Langley Research Center. Within the modifications to the configuration, the significant roles to be played by these international partners remain as provided in the program level agreements concluded with each earlier this year. Their roles are not altered by either the design review or by the work package realignment.

The Space Station work package alignment has also been the subject of extensive review. NASA Center Directors and senior Space Station program officials participated in the review. The result is a recommendation to me from the Associate Administrator for Space Station. I am comfortable with the recommendation. It addresses the concerns raised earlier while maintaining NASA's objectives of utilizing talent throughout the agency and of avoiding an unhealthy dependency upon a single prime contractor.

Under Mr. Stofan's recommendation, responsibility for the laboratory module, habitation module, logistics module and the resource node structure would be assigned to the Marshall Space Flight Center. The external truss, distributed subsystems, EVA systems, airlock and resource node outfitting would be assigned to the Johnson Space Center. Responsibility for Space Station platforms, attached payload accommodations, the robotic servicer, and NASA's role in servicing would be assigned to the Goddard Space Flight Center. The power system would be assigned to the Lewis Research Center.

This alignment of Space Station responsibilities is consistent with the expertise resident in the NASA Centers. It retains General Phillips' principle of end-item accountability so essential to cost control. It maintains the concept of subsystem commonality while preserving the current team configuration of Space Station contractors.

You recall that at our earlier hearing, we had reported on the advantages of the Phillips recommendations, particularly the development responsibility of the habitation and laboratory modules. The recommended approach was to have both modules developed by the same contractor, providing considerable savings in design and manufacturing costs. For example, tooling, fixtures and test equipment for module design and manufacture will now need only be developed by one contractor, a substantial savings when compared to the cost of the unique development of two separate modules by two separate contractors. In addition, I am convinced that considerable savings will accrue to the program in the avoidance of the hand-off from one work package's contractor to another work package's contractor of both subsystem components and partially completed elements. The physical transfer of hardware would have involved packing and unpacking, transportation, testing at both shipping and receiving, maintenance or construction of facilities to handle the

hardware, and a work force to perform all of these activities. This cost avoidance is estimated at $200-300 million in labor and hardware cost, with additional probable savings in saved time to the program.

This work package alignment would assure the Johnson Space Center's continued preeminence in the development of manned space flight systems and operations during the Space Station era, and would make maximum use of JSC existing facilities, organizations and trained personnel, thus avoiding additional investment cost of a transition. Likewise the recommendations made maximum use of the substantial and unique technical and managerial experience of the Marshall Space Flight Center with orbital laboratories.

The Marshall Space Flight Center, through its contractor, would have overall responsibility for the Space Station laboratory and habitat module. In recognition of Johnson's unique expertise, the Johnson Space Center would have technical and contractual responsibility for the manned space subsystems, components and hardware of the habitat module. As Mr. Stofan will explain further, this would be exercised through a unique "exhibit" within the Marshall contract for the definition, design, development, test and delivery of those manned systems. Such items are specified in a Memorandum of Understanding between the two Centers which outlines each Center's responsibilities. The exhibit would maintain Marshall's - and its contractors - overall managerial responsibility. Contractors and subcontractors working on the habitat's manned space subsystems would report to the Johnson Space Center which will retain in Houston responsibility for related R&D, test beds and training.

A similar exhibit will be established in the Johnson contract. Technical and contractual responsibility for the engine elements of the Space Station's propulsion system would rest with the Marshall Space Flight Center, in recognition of its expertise in that field.

There are no plans for personnel shifts between Marshall and Johnson. Test beds, training facilities and research and development activities related to manned systems would remain at the Johnson Center. The proposed work package alignments envision stability in personnel at both Centers.

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Mr Chairman, I hope this review, and that to be provided now by Mr. Stofan, satisfies the Committee's request for a report on Space Station activities. Much work needs to be done if we are to meet the President's goal of having a permanently manned Space Station operational in 1994. I believe we have most of the ingredients in hand: a strong start on Space Station design, an extremely competent NASA - industry technical and management team, a solid framework for international

cooperation and both a vision and dedication that rank among the finest in the country. With your continued support and understanding, we are ready for the challenge ahead.

Let me now ask Mr. Stofan to discuss the configuration and work package review with you, after which we will try to answer any questions you may have.

Mr. STOFAN. Mr. Chairman, I would like first to run over a sequence of events leading up to the meeting with Dr. Fletcher and my recommendations, and then I would like to use the visual aids I have to point out in detail what we're doing.

But before I get into that, with your permission, I would like to invite two individuals up to the front table: John Aaron, who is head of the level B and has been an integral part of the process; and Ray Hook, from Langley, who has done a fantastic job with that team down at Langley that conducted the review for me.

Mr. NELSON. Welcome, gentlemen.

Mr. STOFAN. OK. The process that brought us here, our final set of reviews started last Monday, and the reviews were conducted with the task force at Langley, and the review was presented by Ray Hook to my evaluation committee that was made up of senior members from the centers and also representatives from the science community.

We reviewed the details of their various options on Monday and Tuesday. Tuesday afternoon we brought in the center directors from the various centers involved, went over the results with them. Also, at this time we reviewed the work package distribution. Now this was done separately from Ray's operation in that we wanted to keep the technical look at the station totally separated from the work package distribution. And John Aaron headed that group, and that group was made up of the various work package managers plus some individuals from my office. So there were really two presentations made to my group and eventually to Dr. Fletcher.

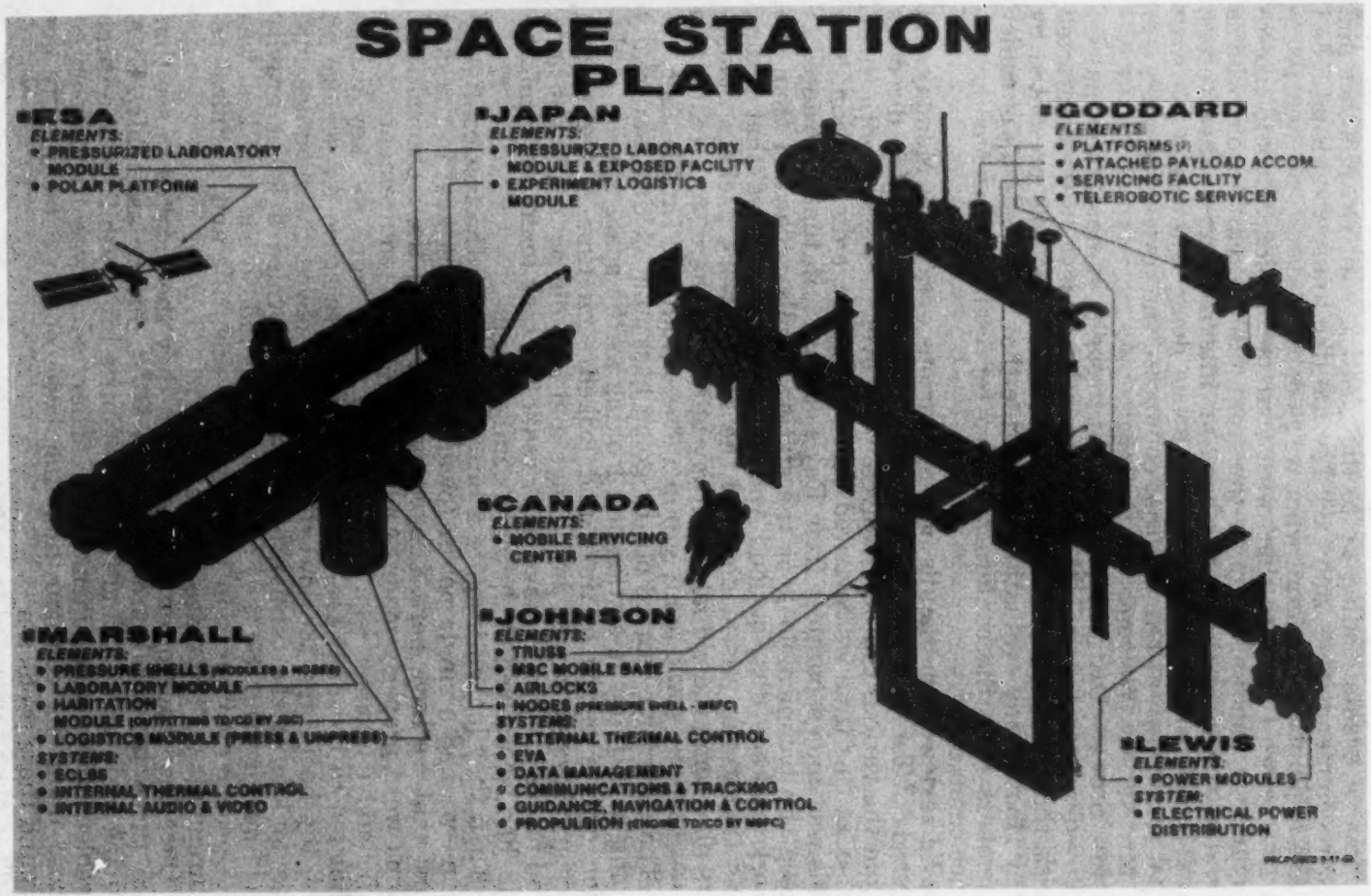
The task force started out by going back and looking, and really going back into the sixties and looking at the space station evolution over a period of time, and looked each time at the station design changes, why it did change and how did we really get here, and it was kind of to make us or make the task team feel comfortable, had we arrived at the right configuration.

Then they looked in quite a bit of detail from the last configuration—we had a single power tower. Had one long keel to the dual keel that we have here. Looked again to see if the technical decisions were properly made. And they took the requirements, scientific and customer requirements, and those were the key things that led to the dual keel that provided more space for science on the top boom and the lower boom. Also, moved the modules into the middle of the configuration, which provided a lower gravity field during orbit. So they confirmed that indeed the dual keel was the proper configuration to satisfy the scientific and technical requirements for the space station.

Once they had gotten to that point, they then looked to see that the three technical problems—the EVA during assembly, EVA during maintenance, and then the shuttle lift capability—the three problems that were mentioned earlier, what was the impact of those upon the configuration and how could we technically get around those problems.

They then proceeded to come up with a series of options of different ways to solve those technical problems, and again came up with the solution. And I would like to use the visuals to walk through that.

[A chart, "Space Station Plan," follows:]


SPACE STATION PLAN
•ESA
ELEMENTS:
• PRESSURIZED LABORATORY MODULE
• POLAR PLATFORM
•JAPAN
ELEMENTS:
• PRESSURIZED LABORATORY MODULE & EXPOSED FACILITY
• EXPERIMENT LOGISTICS MODULE
•GODDARD
ELEMENTS:
• PLATFORMS (2)
• ATTACHED PAYLOAD ACCOM.
• SERVICING FACILITY
• TELEROBOTIC SERVICER
•CANADA
ELEMENTS:
• MOBILE SERVICING CENTER
•MARSHALL
ELEMENTS:
• PRESSURE SHELLS (MODULES & NODES)
• LABORATORY MODULE
• HABITATION MODULE (OUTFITTING TO/CO BY JSC)
• LOGISTICS MODULE (PRESS & UNPRESS)
SYSTEMS:
• ECLSS
• INTERNAL THERMAL CONTROL
• INTERNAL AUDIO & VIDEO
•JOHNSON
ELEMENTS:
• TRUSS
• MSC MOBILE BASE
• AIRLOCKS
• NODES (PRESSURE SHELL - MSFC)
SYSTEMS:
• EXTERNAL THERMAL CONTROL
• EVA
• DATA MANAGEMENT
• COMMUNICATIONS & TRACKING
• GUIDANCE, NAVIGATION & CONTROL
• PROPULSION (ENGINE TO/CO BY MSFC)
•LEWIS
ELEMENTS:
• POWER MODULES
SYSTEM:
• ELECTRICAL POWER DISTRIBUTION

Mr. STOFAN. Here we see the problem that was being investigated. There were also some small but I think very significant changes in the basic design, and that is, we came up with four nodes, shown here, the orange areas. Before there had been a small node and a passageway and then another node at each end. There were six elements, there are now four. And they were much smaller. These now are expanded in volume about another 4,000 cubic feet of space, and also they are now large enough to put a set of racks inside of these nodes. So we have added volume where we can conduct research and conduct—and put equipment.

What we did then is take the equipment off of the transverse boom, and this equipment was guidance-nav, and control. Put that into the nodes, took some of the equipment and control functions out of the hab and lab modules and put those into the nodes.

That then left us with equipment in three of the nodes. This also shows where the airlocks are located for EVA. That then left two of the nodes, the primary and a backup command and control function for the space station. That also meant that the modules then had more room. The hab module had more room and the lab module had more room to conduct science when we took these other systems out of those modules.

This again, then, we're taking the equipment off the transverse boom to help solve the EVA problem for maintenance and repair.

One of the other changes was that during the assembly sequence, when we had the configuration up where we have just the main center lateral boom, is that we have a mobile arm that traverses back and forth across the boom that will help during assembly.

We also have an arm on one of the nodes, or modules, that assists in assembly. And with the shuttle mobile arm, you can use the three of them to do some of the assembly to cut down on the EVA. This, again, was a great help in the assembly sequence.

We also moved the servicing facility from up on the top down to the area near where the modules are, which means it's easier access for the astronauts to leave the modules and go into the area to repair the spacecraft.

The other thing in the assembly sequence we did is get—after the seventh or eighth flight we had the hab and lab module up, which gave us a permanent manned presence, which means we could assemble the rest of the station with the use of the robotics but also from men operating out of the modules in the hard suits rather than the soft suits, which is a much more efficient assembly.

So I think the assembly sequence and the changing of the nodes to make them a volume that we could—that's usable and bringing the equipment into them I think solved all of the technical problems we were facing.

Now, as far as the work package goes, we have three arrangements signed between the centers, and I have signed and presented to Dr. Fletcher, a distribution of the work packages that I think solves the management problems and also the problem of making sure that technical expertise of the centers is used.

The first one is in the lab module—or hab module where the question was with the manned outfitting of the module. We have solved that by putting a section in the contract, an exhibit in the contract, of the Marshall contract that will be managed technically

and contractually by the Johnson Space Center to make sure that the proper manned systems are put into the hab module.

Also, for the propulsion system, the technical expertise existed at Marshall for the hydrogen-oxygen propulsion unit, and they will have, again, a technical and contractual direction in the Johnson contract where Marshall will direct the development of the engines themselves.

The third area was in the nodes; and there, we settled that—again, through an arrangement with the centers and myself. The structural element of the nodes is part of the total pressurized volume that we have and where men will spend time. So the structural element will be developed by the Marshall contractor, totally tested out and checked out, and then that node will be delivered, the three of them, to the Johnson Space Center where they will install all of their equipment inside, and then the contractor can check out the equipment and deliver the node to the cape for launch.

The fourth node at this time is empty. We do not have equipment designated to go into it. So the eventual responsibility of who puts the material in and where it goes to be outfitted and sent to the cape remains to be determined yet. But I'm sure with the innovative engineers we have that we'll have more equipment to put in there than we can fit in.

So that solves the arrangements with the work packages, and we feel now that we have a technical configuration that I am totally comfortable with, the overview team, the center Directors all feel comfortable with, and I think we have a work package distribution that preserves the technical expertise of the centers and also is as economical as can be by having contractors responsible for total checkout and delivery of an end item. So I think we have preserved the Sam Phillips' recommendations also.

Now what I'd like to do next is show a very short computer graphics demonstration of a proposed, or a computer graphics demonstration of the assembly of the space station. It'll take you through some of the first part and then there will be a flyaround of the completely assembled station.

Mr. NELSON. Mr. Stofan, on the chart show us how you have the capability to expand on the U.S.A. modules? Where would you attach additional modules?

Mr. STOFAN. The ports around the nodes would be the attach ports, and you can grow either upward or outward or out the other way—that way. So you can go in essentially three or four dimensions expanding and adding modules onto these nodes, and that's exactly what they're designed for.

Also, I didn't point out that there is a dome here. It's a cupola which the astronauts can be in this area and with the use of the remote manipulators, they can visually see and use the remote manipulators during assembly. It adds to the, again, efficiency and cuts down on the EVA when they do that.

Mr. NELSON. Because there's the capability as well for ESA and Japan to expand their modules?

Mr. STOFAN. Their modules, no. They are limited to the ESA module and the Japanese module here with its back porch and logistics module. If they wanted to add, they would have to come

back and add to the nodes that we have. If they wanted to add another module. Right now they're planning just to have one of the modules, a lab module from each one of them.

Mr. NELSON. Architecturally it is possible for them to expand?

Mr. STOFAN. Yes. Architecturally there is, just as well as the United States could hook into the nodes. If they came back and wanted to, they could. But I think the capability exists for expansion. Canada, again, they would provide the remote arm, the one that transverses and also the fixed arm. And then eventually there it would be taken care of with the larger manipulator that goes up and down the booms to service and bring instruments in from that area.

I think we have satisfied the requirements of the international partners on this design also.

OK. We could take down the board here, and we'll start the video. Now it's just a 4-minute video, and it goes rather quickly.

[Video presentation.]

Mr. STOFAN. And the first one, the first set or series of shots will show an assembly of the very first element. It shows the boom being built up out of the back of the shuttle payload bay. And you'll be looking down in toward the tail of the orbiter.

This, again, the critical evaluation task force configuration will go through.

OK, this is again a truss assembly. You can see you're looking back in toward the tail. And the sections of the boom that are going up are being—would be assembled by astronauts on EVA and then each section moved up as it's being built. And the one you just saw go by was the rotary joint for the photovoltaics system. And it's a section at a time, and it's automatically moved up one at a time as it slowly comes back out of the bay of the shuttle.

The next shot will show the deployment of a radiator. And then we'll have the deployment of the photovoltaic solar array. And we now have a powered piece of a spacecraft. And then the node would be hooked on the bottom, and then we have a flyable spacecraft at that time.

This is the lab module going up. This is the arm from the orbiter attaching onto the lab module, rotating it up out of the shuttle bay. And you can see it moving it into position to lock into one of the nodes. And I think that shows the different ports around the nodes, and it's expandable. You could add other modules to it.

Those are the—that's it being hooked into place, and then the arm folds away. And you can see, here is the airlock that I mentioned before.

We will now take a view around the completely assembled space station, and again we have developed computer graphics for the entire sequence.

This is the free flyer that is behind the station. And this is an OMV attached to it that lets it move away and come back to the space station.

Flying over the free flyer and approaching the station. Again you can see the power system, solar dynamic and photovoltaic, at each end of the lateral boom and the instruments mounted on the upper boom.

I would say, in this assembly sequence, we have also provided for scientific return of our instruments during every single assembly phase, so we get the use of the station at all times.

Here we are flying in now, inside of the servicing facility. And that's a semiclean room facility environment where the astronauts can repair spacecraft. This happens to be showing a space telescope end, which was one of the considerations for early use, to either repair or change out the focal plane instruments on the space telescope.

Now coming out of the other end of the servicing facility you can see the remote arm that's used to handle the spacecraft. Again, here are the modules and the nodes.

This sequence shows the berthing of the shuttle, and you'll notice the shuttle does not fly up and dock. It flies up and stops, the arm reaches out, and it pulls the station and the orbiter together, and this reduces the loads on both the orbiter and the space station.

Again, now we're going underneath the servicing facility to go up around the top of the station to take a look at the other attachments on the station.

This shows the logistics module, the U.S. logistics module that is used to bring material up and down from Earth. It's attached to the module right now.

Now coming around on the other side, here again are your nodes. And this will be your European and Japanese modules attached to the station. And here is one of your remote manipulator arms.

Again, this shows the logistics module for the Japanese module. And here is the remote arm that traverses the middle beam with the manipulator attachments on the end.

We are now going up the dual keel, up the middle; going over top of the space station; and here you can see your scientific instruments, and these are the ones that are all looking out—astrophysics-type experiments or solar. And also the antenna onboard.

We are going over now and come down the other side of the station. And this is looking right back into the shuttle. Where we were behind it, now we're coming down on top of it. You can see the nodes and the main modules.

Again, this is in the completely assembled final configuration of the space station.

That concludes the visual presentation.

Mr. NELSON. Thank you. It's an excellent presentation. You all have done quite a bit of work. We are most appreciative of you coming forth with this revised plan for the architecture, for the management, et cetera.

Now let's talk a little bit about getting the space station up. Mr. Stofan, you mentioned that once you get part of the tower up with the photovoltaic array plus one of the nodules, you now have a habitable station; is that correct?

Mr. STOFAN. No, not a habitable yet. The first launch element will be photovoltaics, a boom, a node that has the electronics guidance and control and has a propulsion system. Now that can't be manned at that time. That unit flies as a spacecraft. It's left up there and flies alone.

Then the second flight we put up exactly the same configuration going out the other way, and you end up with your total lateral boom and it will have two nodes on it.

It is not until about the fourth or fifth flight where we bring up the lab module, and then we have what we call a man-tended. And the lab module gets up, it's about half full of equipment. Another flight brings up the rest of the equipment to fully outfit the lab module. But that's still man-tended. Men can go in and work inside, but they must go back with the shuttle to ground because the hab module is not there.

And it's like the seventh or eighth flight where the hab module comes up. Then we have a permanent manned configuration at that point. I think it's the eighth flight we have the permanence in space.

Mr. NELSON. And to assemble, you are anticipating 18 flights?

Mr. STOFAN. Yes. Assembly flights, 17 or 18. And then, of course, during that time there would be logistics flights, and also consider the free-flyer flights, either polar- or the co-orbiting platform.

Mr. NELSON. And is that what is considered, as stated in Av Week, 31 flights?

Mr. STOFAN. Yes. The 31 flights are the 17 assembly flights for just assembling the station. The rest of the flights are logistics, two polar-orbiting platforms and a co-orbiting platform make up the total of 31. The logistics flight, especially as soon as you get a permanent manned presence onboard the station, you need—every so many flights you need a logistics flight to supply the astronauts with their needs.

Mr. NELSON. Over the course of how long in your most recent scenario do you anticipate the total construction of the space station?

Mr. STOFAN. If we have the eight flights a year which we are anticipating, we will start in early 1993 and end in late 1994, so it's about 2 years of time to get to what we call IOC. For 31 flights, the full 31 flights, again, if we have 8 per year, that takes then about 4 years to finish that entire sequence. So that would take us out to 1993, 1994, 1995, 1996 to get to the end. But permanent manned would be by 1994.

Mr. NELSON. And within that figure, you are talking about the resupply and the taking up of crews, which is what you're referring to as the logistical?

Mr. STOFAN. Yes. One of the critical parameters is the crew size for rotating. A crew can stay up 90 days and you can take four crew at a time. With a shuttle load of seven, three are needed to operate the shuttle, and therefore we can take four crew up. And with a 90-day period, we would need eight flights a year to keep eight people permanently on the station, which we intend to do. And then when they're up we have to have logistics flights, but also then the change-out of the science instruments and bringing up more science during that time.

Mr. NELSON. Dr. Fletcher, we have had a running battle this year to finally get the stamp of approval from the President for a replacement orbiter. Now that that's underway and I expect that—this committee, as you know, has already authorized the funding for a replacement. It's my expectation that we will see in the ulti-

mate continuing resolution the appropriations for 1987 for the replacement orbiter.

And making that assumption, that we have a replacement orbiter, then we only have four. Tell me what your thinking is. How can we do all of this, what Mr. Stofan has just described which will take us through, all the way through 1996, and then use the shuttle for all of its other unique capabilities including other science missions? And as part of that question, I want you to discuss the possibilities of a heavy-lift vehicle which might put up sections of the space station.

Dr. FLETCHER. Well, with regard to the first part of your question, how can we do this with four, I remember it was only 2 months ago that we only had three.

Mr. NELSON. That's right.

Dr. FLETCHER. I wasn't sure we could even put up the space station with three. But several things have happened. One is that Andy Stofan and his colleagues have figured out a better way of assembling this, and so with leaving out the logistics modules, 16 or—I think Andy said 17 or 18 flights to assemble this in 2 years. That would be done with four orbiters, which we expect we can fly at least 16 flights per year. So that would leave—what would it be? —seven flights per year left over for other things.

Now that's not a heck of a lot, Mr. Chairman, but nevertheless, it can be used for a number of things like launching military satellites, like launching other scientific satellites, probably some advanced planetary missions, and we haven't thought through how we would do that. It may be that the best way to do that is to assemble them at the space station rather than launch them from the Earth. But whatever the case, planetary missions and other scientific missions.

So four orbiters gives us some flexibility to fly the missions we're scheduled to fly. I wouldn't say it's a healthy margin, but I think it can be done.

Mr. NELSON. Well, now what about the possibility of a heavy-lift vehicle which would complement the shuttle if you only have four? And as you answer that, you might consider do you save a little of EVA time if you launch on a heavy-lift vehicle a fully integrated module?

Dr. FLETCHER. You know, this study group, Mr. Chairman, did not really look with any depth at a heavy-lift launch vehicle. They looked at a Titan IV CELV, and as a matter of fact, that is one of the things remaining to be studied further. To look at a heavy-lift launch vehicle, Mr. Chairman, I think would require looking out a little further in time than this group looked. This group looked at the period from now until 1994 when the complete station should be assembled. If we're looking at a heavy-lift launch vehicle, at least those that are now under consideration, we're looking at a later period of time than that.

Now of course it's always possible in principle to speed up that schedule, but our current schedule is not to have a heavy-launch vehicle ready to go until the mid-1990's.

Now, having said that, my guess is that Mr. Stofan and his colleagues will take a look at what would be possible if an earlier heavy-lift launch vehicle were available. I know that it would be a

very attractive thing for the astronauts because if they are going to stay up for any length of time, they would like to have a little more room to live in. Mr. Stofan may want to elaborate on that, but I don't believe that was part of this recent study.

Mr. STOFAN. No; we looked at it just very briefly, and my oversight committee asked them to not look at it because we did not want to count on having a station, or build a station that would count on having a vehicle there, and then not have it there would just stop us cold. So we stopped them from looking at it.

But I think the basic configuration of the space station would stay the same because the station has been built to meet a set of requirements and those requirements have not changed. I think what would change is the size of the modules and the number of flights. You could take up a lot more at one time, so yes, we could greatly ease the EVA time and do a lot more assembling on ground and provide more living and bigger lab space, but I would expect the station would end up looking, at first glance, would look exactly the way it looks today.

Mr. NELSON. Before I turn to Mr. Walker, let me just follow that up.

Suppose we construct the station as you have outlined it here, using the shuttle as the vehicle, but say about 1995 or 1996 we have a derivative of the shuttle that would take up 300,000 pounds in the place of the orbiter—in essence, you would have a cargo thing on the stack with the engines and the tail, instead of the orbiter, and say you could get up 300,000 pounds.

The question is, would you have the capability of taking larger modules that would be possible to be launched, because you would not be launching in the cargo bay of the shuttle, that would architecturally fit with this? Have you made any plans regarding that?

Dr. FLETCHER. I'm going to interject before Mr. Stofan jumps off too quickly. I think it's a likely possibility, Mr. Chairman, if we have the capability of launching larger modules, so to speak. And that's the nice thing about this nodal concept, that there are six sides to each of these nodes—six ports, if you like—and, of course, on that design you only are using two of them, I think. So you have got room to—I'm using a crude term—to screw on another larger module. Don't worry. There will be plenty of uses for that, if and when it becomes available.

Now you can go, Andy.

Mr. STOFAN. OK. I just checked with—you gave me time to check with Ray here to find out what the right answer was on that.

The team looked at it briefly from a point of view of clearances and, indeed, the clearances are there if a vehicle with over 100,000 pounds of lift capability—100,000 to 150,000 is what is deemed would take up a module of the size that would be adequate. The clearances are adequate.

So, indeed, if we had it, we could take up larger modules and attach them to the nodes, as Jim said.

Mr. NELSON. Mr. Walker.

Mr. WALKER. Thank you, Mr. Chairman. A number of questions to follow up on what the chairman has asked.

Of the 17 flights that would be construction-oriented flights, 17 or 18 flights, can you carry anything else to orbit along with your construction materials?

Mr. STOFAN. We will carry only space station-related equipment on those 17 flights. Each one of the flights is manifested to utilize the full lift capability of the shuttle. When the space isn't used for structure for the station, we load scientific instruments on board so we have the maximum amount of science. So anything left over is immediately dedicated to science.

Mr. WALKER. So those 17 to 18 flights are exclusively space station?

Mr. STOFAN. Exclusively space station and space station science, yes.

Mr. WALKER. The other flights—when we mentioned the 31 flights, I assume, then, that the additional 16 flights or so that are—the 15 flights or so that are contemplated there would be dual purpose missions?

Mr. STOFAN. No; they would be strictly space station missions, also. But by space station, that includes taking up science instruments, bringing back processed materials from space, taking up logistics for people and bringing people back. So they would be associated with the space station.

Mr. WALKER. So the 31 flights that we're talking about for space station, in a fairly short period of time, virtually the entire bay and the whole flight is dedicated to space station only?

Mr. STOFAN. That's right, both the upweight and the downweight is totally dedicated to space station. That's correct.

Mr. WALKER. So for a period of time there, that four-orbiter fleet is going to be stretched pretty well to take care of just space station-related activities.

Dr. FLETCHER. If it's done in 2 years, Mr. Walker, certainly you wouldn't have any left over for other programs, because the 31 divided by 2 is 16, and that's about all we can expect with four orbiters.

Mr. WALKER. Yeah. I assume that the 31 flights are stretched out a little bit longer than the 2-year period, is that right?

Mr. STOFAN. Yes. The 2 years is to the permanent manned presence in space, the permanent manned configuration. That's eight flights. So we start in 1993, and that is in 1994 we will have permanent manned presence. The rest of the flights then stretch out over a period of time, and as I said, if it's eight per year we have, 4 years we'll have the total station configuration in orbit.

Mr. WALKER. You're talking 31 flights. How many years are we talking about?

Mr. STOFAN. About—figuring eight per year, that's 4 years.

Mr. WALKER. It's a 4-year contemplation?

Mr. STOFAN. Uh-huh.

Mr. WALKER. As you know, I have been interested in the whole business, as we go through the process of building the station, that we are creating more than simply one big flying machine up there, that we ought to be creating infrastructure and so on. I think the new design does move us in that direction with the nodule concept. I'm pleased with that.

Let me try to understand how much infrastructure that might give us. If—first of all, the station as now configured, as we see it in your models, how many people would be aboard that station?

Mr. STOFAN. We plan to have eight people up there in the permanent manned configuration, four initially during the assembly, but eventually eight.

Mr. WALKER. So in the permanently manned configuration we're talking about eight people?

Mr. STOFAN. Yes.

Mr. WALKER. In the design, if you maximized your design and looked at the number of modules that you might be able to add on to this station, how big a station could you ultimately get to measured by the number of people that you could have aboard?

Mr. STOFAN. Right now the limitation for the number of people on board is limited by two things. One is the number of crew the shuttle can take up, and the second one is the stay time of the crew. With being able to trade out four people on a shuttle launch for a crew, and having eight launches a year, the maximum number of people we can support is eight.

Mr. WALKER. But let's look beyond the shuttle capacity and think of when we have the possibility, for instance, of an aerospace vehicle that could take much larger numbers of people into orbit. What I'm wondering is, what have we created here in terms of a design, in terms of its expandability? How far can this one design be expanded?

Mr. STOFAN. A lot. I will ask—Ray, do you want to——

Mr. HOOK. Yes. The design is established to carry up to 20 people by adding modules, habitability of modules, as well as laboratories to the station.

Mr. WALKER. So the maximum configuration with laboratories, habitability modules, whatever factory equipment and so on, would be approximately 20 people permanently on orbit?

Dr. FLETCHER. Mr. Walker, could I interrupt a little bit?

Mr. WALKER. Sure.

Dr. FLETCHER. I think that's with the current thinking, because nobody has really tried to go beyond that. But you have to ask what are the limitations that limits it to 20, and I don't believe we've ever asked Ray Hook to look at that. If we added more power modules and larger habitability modules and so forth, I don't know where it would end.

Mr. WALKER. In other words, there is nothing inherent in the design that can't keep you from almost infinitely expanding the numbers of modules that you put aboard; is that what I'm hearing from you?

Mr. STOFAN. Yes; that's correct. In fact, the evolutionary task force that we've had met two or three times, looking out into the future where we would go. We would probably expand it up to about 20 or 30 people, and then the thought is, from their last study, that we probably would build another station rather than just grow one infinitely. We would change it. This one would be a research center in space, and the next one may be a servicing port and a place where you would assemble flights to the Moon and then on to Mars.

Mr. WALKER. In Mr. Fletcher's testimony he mentioned 37½ kilowatts of power aboard the station. Now, he said that's the initial power that would be aboard the station. My understanding is that your plans are to go to 75 kilowatts on the final design.

How long will it take to go from 37½ to 75?

Mr. STOFAN. Flight No. 12, assembly flight No. 9, takes up the solar dynamic power system. Assembly flight No. 9.

Mr. WALKER. So at that point you would be at the potential for 75 kilowatts?

Mr. STOFAN. That's correct.

Mr. WALKER. So before you would really have much in the way of factory equipment or solar furnaces and so on, you would have your full power in orbit, is that a correct assumption?

Dr. FLETCHER. No; I think you would start some of the manufacturing and so forth, even at the lower power level.

Mr. WALKER. Even at the 37½?

Dr. FLETCHER. Yes. It just wouldn't be as extensive as the ultimate configuration. Am I wrong on that?

Mr. STOFAN. No; that's correct. It is the flight No. 6 that we have the U.S. lab module, and that gets us the man-tended configuration. That would have the 37½ kilowatts. That would allow you to do materials processing type experiments on board.

Mr. WALKER. How many furnaces would the 37½ support?

Dr. FLETCHER. That's a good question.

Mr. STOFAN. It depends on the size of the furnace and what else is on board. The manifesting, it depends on all of the onboard power that's required for maintenance of the station, and then what particular rackup of instruments, experiments you have on board. If you had nothing but furnaces, you would have—I don't recall what the power left over at that time—I think it's around 20, 25 kilowatts for the user—at that time could be for furnaces, but it depends on the mix of instruments you have on board and how they're turned on and off.

Mr. WALKER. Was there any consideration given to the potential that's been mentioned by some people in the community of looking at building up power by going to offsite power sources and then microwaving the power to the station? Has that been looked at as a part of your analysis at this point?

Dr. FLETCHER. Mr. Walker, I don't think Ray Hook and his group looked at that. That has been looked at at other parts of NASA—and maybe John knows—because there have been several proposals to that effect which have been evaluated.

Do you want to comment, John, on that?

Mr. AARON. I would say, to the degree we looked at that for the kind of power settings we're talking about here, in the neighborhood of 37½ or the 75, or the growth up to 150 or 300 eventually that the station might grow to in our evolutionary studies, it looks like the practicality and feasibility of that, from the tray stores we have run, says that the configuration we have today is more optimum to have the attached power we have there. Once you get significantly above those kinds of power settings, maybe moving to remote power and microwave and across is a more reasonable configuration.

Mr. WALKER. Thank you.

Mr. VOLKMER. Would the gentleman yield on that line of questioning, just briefly?

Mr. WALKER. Sure, I would be glad to yield to the gentleman.

Mr. VOLKMER. In other words, what I hear is that you're looking solely at photovolatic, solar power, for the space station; is that correct?

Dr. FLETCHER. For the first 37½ kilowatts. Then the second 37½ would be the solar dynamics.

Mr. VOLKMER. Then you're going to go solar dynamics. OK.

Dr. FLETCHER. And then beyond the 75, of course, solar dynamics would probably be it. But that's speculation at this point.

Mr. WALKER. One of the bugaboos that I think some of us have in all of this is, when we see that ESA is going to have a lab module, Japan is going to have a lab module, and we look at the power requirements for doing all these various things, can we be certain we're going to have enough power left over for the materials processing that this country wants to do in order to be at the leading edge. The last thing we want to do is build this station, only to have virtually all of our foreign competitors use up the rather limited amounts of power available and leave this Nation with a station that doesn't really promote an economic future.

Are we examining that aspect of it?

Dr. FLETCHER. Well, of course, Mr. Walker, that's the whole idea of the remote power, microwaved or tethered, whatever it might be. You can go on up from the 75 if we make provisions for it, to double that if we need, or even more.

Mr. WALKER. But what I'm hearing is that that really is not an option that is being considered at the present time.

Dr. FLETCHER. It's not being considered—it wasn't considered in this study. But, after all, Ray Hook has only been involved in this task force exercise and he's got other duties, but John Aaron and his people and Andy and his people have been looking at lots of different power configurations for advanced space station activities.

Mr. LUJAN. Will the gentleman yield for just a minute?

Aren't we doing the SP-100 study for nuclear power, space nuclear power——

Mr. STOFAN. In fact, Lewis is one of the lead centers on doing that study on the SP-100. That is not being looked at for the station right now. Some way-out, future growth version, they're looking at the applicability of that. But growth in power in the station, and to get back to the power question, the solar dynamic systems come in 25-kilowatt units that attach out to the end of the booms. We can keep adding them on to take power, and we have looked at adding up to 300 kilowatts.

Now, the manifesting of the experiments, we have gone through several design cycles and looking at what type of experiments we would have on board and what type of things we'd have in the labs, and laid that out and did a power envelope, and we have enough power to take care of the materials processing experiments that are being proposed by the U.S. scientists. So we are not power short on the station, and if we were, we could then take up more power modules and add them.

Mr. WALKER. Well, this is a discussion for another day because I have more than used my time. But I guess from my perspective it

is important to also recognize we are not just dealing with a station here as we power up, that if, in fact, you went to remote sources rather than simply tie more power to the station, you therefore give yourself the capacity of putting other vehicles maybe into close proximity with the station, maybe into totally different orbits, and also having power sufficient for them for this country; that the offsite power concept goes beyond what is available to station, and yet, if we look at that design and understand a station could utilize that kind of power, it seems to me you get a blend of a couple of different things in terms of infrastructure for the future.

That's the reason I would kind of like to see us, if we're talking about powering up, look to that kind of concept, because it has applicability then beyond station.

Thank you, Mr. Chairman.

Mr. NELSON. Mr. Chapman.

Mr. CHAPMAN. Thank you, Mr. Chairman.

Let me discuss, if I may, or ask if I may, some questions about the timetable. As you are aware, the language that was adopted by this committee in the August 5 hearing had to do with this report. The question now—I think I heard you say that you anticipate within a month or so that report to be completed.

What I would like to know is for you to put in context, if you will for me, if we were on the one hand to accept this report today as satisfying that requirement, versus waiting for the formal report which would have presumably a lot more detail in it about what finally will occur, and also a lot of the cost figures which we do not have at this time.

Would you address for me first specifically what information you would expect to gain between now and the time you can file the detailed report, what information would be in that that we don't have today, and if the language in the committee report should be passed into law, what are we doing to the time line? If we waited and followed the language, should that come out of the conference report, what are we doing to the time line on the RFP's and where we go from here, should we wait for that detailed report?

Dr. FLETCHER. Let me answer the first part of the question first.

Actually, you've got today 85 or 90 percent of what needs to be done, because basically you've got a configuration and an assembly sequence which seems to satisfy the ground rules that we set up for this study. What remains to be done is make some kind of an estimate of what additional costs there may be because of this assembly sequence.

We didn't try to restrict the cost, although we were careful about the cost, but we did add these extra, the larger nodes, and we did rearrange the configuration some in order to fit the constraints. I think that needs to be pinned down a little better before we go ahead. But there are some indications that it may not be any noticeable increase in cost, but it does need to be scrubbed, so to speak.

Another factor or piece of the problem which wasn't looked at, but I think we want to be able to say we've looked at all variations, was the possibility of using a Titan IX which will be available at this time. As I indicated, we did not look at the heavy-lift launch vehicle because that occurs farther out in time. Titan IX, however,

has about the same payload capacity as the shuttle itself. They did look at the Titan IX capability and there were some problems with it having to do with attitude control, as I recall, Ray, things of that sort. But I think it needs to be pinned down a little better, that you couldn't use the Titan IX because, as the chairman indicated, we are marginal on the number of shuttle flights that are available.

Last but not least—this is complimentary in a way to the group—they did such an outstanding job of dividing the work packages into appropriate accountability that it almost looks as though you can go off and everybody build his work packages without very much of a systems engineering job and management from headquarters. I know that seems a little inconceivable, but they really are well-designed work packages now.

Somebody from General Phillips' group raised the question, "Well, now, how does the management group interact with the centers in making sure these work packages fit together and are managed appropriately?" That shouldn't take very long, but that's another factor that needs to be looked at. We expect to have all that done within a month or so. I don't know how you want to handle it, but we would give you—we would send you our results on those remaining issues.

I don't know how that affects the schedule. That was the second part of your question. It will depend on how this committee wants to handle it. It also depends on whether you're going to recess until next year or whether you're coming back after October. I don't know the details of that. You can maybe give me some guidance on it, Mr. Chapman.

Mr. CHAPMAN. Somehow the powers that be have yet to share that vision with me, so I don't have the answer to that at this time. I'm not sure that anybody does.

Let me ask this at this point: Based on what you know to be or anticipate to be the recommendations of Mr. Stofan and the work that's been done during this review, do you see, or do you perceive at this time, any—and by any, I mean small—any significant change that you anticipate might occur in his recommendations as to how this project would proceed?

Dr. FLETCHER. Mr. Chapman, I'm optimistic that it will go down pretty much as Mr. Stofan and his colleagues have recommended it to me. Remember, that was only a week ago yesterday and we do have to be sure we're on the right track before we go out with those RFP's. We do plan to go out with the RFP's, though, at least draft RFP's, mid-November or thereabouts. I don't see any major changes in those.

Mr. CHAPMAN. What would your plans to go out with those RFP's—if this committee should say we're going to adopt that language and we would like to wait and see the final report, how would that affect the time line of your going out with the RFP's, if at all?

Dr. FLETCHER. Again, Mr. Chairman, I guess that depends on when you meet again. If you decide to meet in November, it won't hold it up at all and we come back to you and present it just as is; if you decide not to, then we have a problem.

Mr. CHAPMAN. Are you able at this time, or do you have any idea, talking in terms of cost, within the framework of the overall

cost to get from here all the way to a fully assembled space station, are we within—again, understanding the limitations of the information you have right now—are we within the ballpark, are we in the ballpark of total cost as has been anticipated?

Dr. FLETCHER. Mr. Chapman, that's a very good question. You see, there are two separate questions. One is, How much, if any, additional cost was added by this reconfiguration that we just went through, and the other question is really the $64 question, How much is this really going to cost? And remember, not last time but probably the time before that we appeared before you, we said we would have the results of our overall cost estimates ready for you at the end of this calendar year. We're probably not going to make it that soon, but we're aiming at mid-January, I believe, for an overall cost.

I am hoping that the overall cost won't be excessive. But I wouldn't want to promise that at this time until we've really scrubbed this thing a lot better than we have.

If the overall cost does seem to be excessive, we may have to scale down this configuration. But that's the whole idea of making this assembly sequence such that you could stop any place along the line and it would still be an extremely useful space station. So either way, I think we're in good shape, no matter how the cost turns out.

Mr. NELSON. Would the gentleman yield?

Mr. CHAPMAN. Surely.

Mr. NELSON. On the question of the RFP that you asked, in which Dr. Fletcher said the middle of November, you have now formed this new task force on operations. When is that going to report to you?

Mr. STOFAN. That will report by the end of the year.

Mr. NELSON. Should you not have that report before you issue your RFP?

Mr. STOFAN. We're issuing the RFP—November 15 will be draft RFP for comment to industry. Final RFP will be issued after the first of the year. So we will have the results of the operations task force to go into the final RFP. And also, once the final RFP is issued, if the task force comes up with something right near the very end of the period, we can always amend the RFP and get that information in. We fully intend to have the results of that task force incorporated into the RFP's.

Mr. NELSON. So you're looking at the hardware baseline being finalized after you have the operations task force report?

Mr. STOFAN. The operations task force will baseline the fundamental ways we're going to operate the space station, the ground rules. And so for the contractors to do a total pricing and any impact operations would have on the design or ground or airborne equipment, they would have that information so they could propose that back to us. It would be incorporated prior to the time we signed contracts with them.

Mr. NELSON. OK. I want to make sure I've got that sequence.

The preliminary RFP mid-November; the final RFP——

Mr. STOFAN. The first of the year.

Mr. NELSON. The first of the year. And that's after you've gotten your operations task force report by December 31?

Mr. STOFAN. Yes, sir.

Mr. NELSON. Mr. Lujan.

Mr. LUJAN. Thank you very much, Mr. Chairman.

I'm not quite sure why you want us back in session in November, but I'm not too sure that you have——

Dr. FLETCHER. That wasn't my idea, Mr. Lujan. I don't want to come back to this committee if I don't have to.

Mr. LUJAN. Are you referring to the wording in the authorization bill when you said we have to approve what you do? Is that what you're referring to?

Dr. FLETCHER. I think that's what Mr. Chapman was referring to. I would hope that this report today would, followed by whatever questions you may want answered about the configuration and the work packages, would satisfy the language of the bill.

Mr. LUJAN. The 30-day clock to start running today, is that what you mean? Because we don't have the authorization yet. We probably won't have it until the continuing resolution or, if that is in there——

Dr. FLETCHER. I would say yes, I would say the 30-day clock should—from our point of view, I would hope it would start running today.

Mr. LUJAN. What happens if—you're not going to be doing anything until, what, 1993, or building until 1993. That seems an awful long time that this 30-day hiatus over here is going to make such a big difference. It seems like it's insignificant, a 30-day delay.

Dr. FLETCHER. Mr. Lujan, that's right. It always seems like a small slip at the beginning ought to be a small slip at the end——

Mr. LUJAN. Yeah, but you're not going to sit around twiddling your thumbs for 30 days. You're going to be doing some other things. You're going to be moving ahead, I would imagine, rather than all of the NASA organization sitting over there with their arms crossed waiting for Congress to approve.

Dr. FLETCHER. Yes, your point is well taken, Mr. Lujan. Thirty days isn't going to kill us. I don't know how to say this any better, but we and the people at the centers and our contractors are anxious to get on with the job. They've been working very hard for several years to this point and we don't like to have an extra 30 days thrown in right when we're ready to go.

Mr. LUJAN. I agree with you. I agree with you totally. I'm probably more concerned that we're not going to meet the 1992 date, which we originally set as the 500th year. As a matter of fact, here about 6 months ago I gave a guy by the name of Christopher Columbus the 17th or 18th, 16th, something like that, that was in my office. I thought gee, you know, that would be great if we could have this guy go on up there. Of course, he turned white when I suggested it.

But can't we do anything symbolic, hang a sign "Future Home of the Space Station" or something in 1992, or maybe have somebody just walk in and out of the living model, module, or something? Can we do anything in 1992 that is very symbolic, that says this is where it all started, colonization of space?

Dr. FLETCHER. Mr. Lujan, NASA, the agency, has been looking at what we should do in 1992, but as of this day, I'm going to ask Mr.

Stofan and his colleagues to see what he could do with the space station on that date.

Mr. LUJAN. Well, it certainly would be, I think—you know, one of the things that we need right now for NASA, it seems to me, is the same kind of PR that we used to have. That would certainly go a long way.

Well, you say the contractors are anxious, NASA is anxious, this committee is anxious. As a matter of fact, I guess the whole—the entire country is anxious to get started on this. When do you think people can start bending steel and doing things together and all of that sort of thing?

Dr. FLETCHER. I think when the first contract is let, or perhaps even before, we ought to start bending steel. I think the current plan is midsummer of 1987—Andy, is that about right?

Mr. STOFAN. Yes.

Mr. LUJAN. In all of the different modules and the keels, all of it, or——

Dr. FLETCHER. Well, of course, different contractors will start at different rates. I have forgotten how many contractors there are all together, but actually some of them, like the TMIS contractor, will be starting earlier—and he won't be bending steel; he'll be putting computer parts and software together. But on or about August or thereabouts of next year, some of the contractors will actually start building, say, modules and nodes, things of that sort.

Mr. STOFAN. Yes. Since it is launched over a period of time of 4 years or more, we look at the assembly sequence very carefully, and the things that have to go up first are where the funds will go to first. So it's a matter of funding the proper things in the beginning to get the launch sequence to support it, because we launch over a number of years.

Mr. LUJAN. You can't tell us at this time that you can build it for $8 billion; is that what you told us a little while ago?

Dr. FLETCHER. We're going to be able to build some major portion of that, if not all, for $8 billion, because that's what my predecessor committed to and we're going to have that at least as one option.

Having said that, though, Mr. Lujan, it seems to me—now, I'm really reaching a little bit—if it turns out that it's $10 billion, say, instead of $8 billion, or thereabouts, we may come back and ask you to support us on a full configuration for whatever our best guess is. What I am not going to do, though, is come back to you and say it's $8 billion when I know darned well it's $10 or $11 billion. That's what I want to be sure I don't do.

Mr. LUJAN. Are we adding to your dollar problems by saying this center has to do this and that center has to do that?

Dr. FLETCHER. At the present time I don't think so. Mr. Stofan and Mr. Hook can answer that because they've been right in the middle of it. But the extra cost, if any, over the previous assembly sequence would be primarily the addition of those nodes. Those nodes were added not so much for the work package considerations, but rather from the point of view that each part of the assembly sequence is a useful sequence and can do science and space processing and so forth. If that's what it's for, it might be worth the additional cost, if there is any.

Mr. LUJAN. Well, just from a layman's point of view, it seems to me like that makes a lot of sense.

The new baseline design, that you have two keels instead of one, does that add to the cost, or do we get two for one at the same cost?

Mr. STOFAN. The keels themselves, the tubular structure, is not very expensive at all. The expense is in really the basic design and the modules and the living area and the remote manipulators, rather than in the simple structure.

Mr. LUJAN. Thank you very much.

Thank you, Mr. Chairman.

Mr. WALKER. Would you yield for just a moment?

Mr. LUJAN. Yes; I would be happy to yield.

Mr. WALKER. One other thing. I would hope to build on the statement you just made, Dr. Fletcher, about the cost. I would also hope that you would come back to us and tell us if the cost considerations that are either being imposed by Congress or being imposed by the system as a whole are having adverse effects on the technological achievement of what we're trying to do here, because I think one of the valid criticisms that has emerged on the shuttle is the fact that at the time it was being designed there were cost constraints put on, that there may have been some things done that impacted on the system later on. I think we need to have a very honest dialog between this subcommittee and NASA about those kinds of issues as they arise with regard to space station. We can ill afford to have another situation where we think we are cutting costs, where NASA seems to confirm that we're cutting costs and not having an impact on the program, only to find out later that it did have an adverse impact to the detriment of the whole program.

Dr. FLETCHER. Mr. Walker, we don't plan to cut costs in that way. If we have to cut costs at all, we will cut it by descoping the program. But as I tried to indicate earlier, if we're wrong a little bit on the cost, then we'll come back and probably ask you for the full amount of whatever that cost. What I don't want to do is what you just suggested—cut costs and have to pay for it later. I don't want to do that. Also, I don't want to misrepresent the cost, neither of those two things, and I want to be sure we're right when we start it this time.

Mr. WALKER. I thank you, and I thank the gentleman for yielding.

Mr. NELSON. Mr. Volkmer.

Mr. VOLKMER. Yes, Dr. Fletcher. In reviewing your statement—I'm sorry I wasn't here at the beginning—and in listening to the questions and answers that have been brought out about this 30 days, I find that, if I review your statement correctly, you haven't made a final decision on the design modifications themselves; is that correct?

Dr. FLETCHER. Not the final modification because basically, as I mentioned, there are three things that really weren't pinned down. One is the thing we were just talking about, what additional costs for the configuration changes. The other is can we really not use the ELV's, the Titan IX's, which will be available during this time period. And last but not least, is how are we going to manage that, now that we have so neatly set out these work packages.

I don't think those are major considerations, but I think we have to have a neat package before we go ahead, and those remain unanswered.

Mr. VOLKMER. Well, I think, in listening to the questions of the gentleman from New Mexico and the gentleman from Pennsylvania just a few minutes ago, and I have the same concerns as to where we're going as to costs. I quite agree with you, that if it does cost just a small amount more to do something a little bit better, that it may be better to do it that way. But I think that the Congress is entitled to know that that's the way we're going to go, or propose to go, rather than NASA going off and doing it on its own. You understand what I'm saying?

Dr. FLETCHER. I understand very well what you're saying, Mr. Volkmer, and I don't want to do that.

Mr. VOLKMER. I quite agree with you. So far my preliminary finding, Mr. Stofan, with the modifications, they seem to make more sense as the way to do it, and I agree with that, the design modifications. But I perhaps have a little bit as the same misgivings as some of the other members of the committee, as to why the 30 days is going to be so detrimental.

Dr. FLETCHER. Well, I think, Mr. Volkmer, I don't want to mislead anybody. There may be a misunderstanding on the 30 days. But I think the 30 days fits our draft RFP date of November 15, and our final RFP date of the end of December. If I'm mistaken, somebody ought to let me know.

Mr. VOLKMER. I am sure that you will be furnishing the staff here copies of your draft RFP so that the subcommittee staff will have an opportunity to review that?

Dr. FLETCHER. I think that would be possible. The RFP I think is public information, so we can do that.

Mr. VOLKMER. Right.

Dr. FLETCHER. What we can't do is show you the contractor reports right away. That's proprietary.

Mr. VOLKMER. Of course, the 30 days we're talking about, technically, as I remember, was supposed to be while Congress was in session. I don't think we're going to be in session much past October 10.

Mr. CHAPMAN. Will the gentleman yield?

Mr. VOLKMER. Yes; I yield.

Mr. CHAPMAN. The reason—my concern was not just the 30 days, but if we are to wait for the detailed report that comes in a month or so—let's assume or so is another 2 weeks—we are 6 weeks out from getting the report and Congress is in recess, not to come back until January, then under the language of that authorization what we're talking about is 30 days from the time we start again. So we're looking not at mid-November. We're looking at mid-February.

So that's why I was asking, what does that do to the time line if——

Mr. VOLKMER. That would hurt, Mr. Chapman.

Mr. CHAPMAN. That's why I was asking.

Dr. FLETCHER. Yes; that would hurt, Mr. Chapman, if that language is interpreted that way. I guess I didn't read it that carefully.

Mr. VOLKMER. That would put you in your RFP process pretty far back, then, would it not?

Dr. FLETCHER. Yes; it would.

Mr. CHAPMAN. Well, it's 30 days after the report is filed with the committee, and if Congress is not in session, that presumably could be in February.

Mr. VOLKMER. I yield back the balance of my time.

Dr. FLETCHER. That is 30 real days, not 30 legislative days.

Mr. VOLKMER. I'll let somebody take this up. I have another meeting to go to.

Mr. NELSON. Mr. Barton.

Mr. BARTON. Dr. Fletcher, and, Mr. Stofan, I want to commend both of you. Since some of our previous hearings, both public and private, it appears that you both made a good-faith effort to address some of the concerns that the committee, and I think the Texas delegation, in particular, had about some of the previous decisions, tentative decisions that had been made. I know Mr. Stofan has spent a considerable amount of time going around to the various Members on the committee, and Members not on the committee that are concerned, briefing them individually, and we appreciate that.

I do want to refocus the hearing a little bit, ask a few of the basic questions. That was one of the original purposes. In order to that I think it would be appropriate to read the language that we've been talking about in terms of the 30-day period. It says:

> Funds authorized to be appropriated pursuant to subsection (a)(1) may not be obligated or expended for the purpose of reassigning any technical work responsibilities on a permanently manned Space Station until after the passage of 30 calendar days during which either house of Congress is in session following the submission of a report by the Administrator to the Committee on Science and Technology of the House of Representatives and the Committee on Commerce, Science and Transportation of the Senate.
>
> The report referred to in paragraph 1 shall include a full justification in terms of anticipated costs and benefits, management factors, and impacts on facility and personnel resources of any such proposed reassignments.

Now, Dr. Fletcher, and, Mr. Stofan, I have your report that you have submitted to us today right here, if I can get it. It's quite possible that Chairman Nelson has got a more extensive report or that the staff does. I've carefully read this report. Everything I see in it looks like we're moving in the right direction. Mr. Stofan has a team called the CETF team—the critical evaluation task force—and they're working like beavers down at Langley to do the cost analysis and all those things.

I see one reference to costs. On page 5 it talks about it's estimated that some of these proposals will save $200 to $300 million in labor and hardware costs. There's a paragraph that says that there are no proposed changes in personnel between Johnson and Marshall. There's a lot of talk about redesign of the space station, itself. But in terms of a full report and full justification of anticipated costs and benefits, management factors, impacts on facility and personnel resources, I don't see it.

So my question is a very simple question. Giving you full faith and patting you on the back, or lower, if that's where you want to be patted on, but wherever, I think you're trying to do a good job. But my question is, When do we see the report as outlined in our

authorization language? And if we're not going to, in this one member's judgment, and I haven't talked to Chairman Nelson or the ranking minority members on the committee, I don't feel like that you've totally complied with the request.

So what are you doing? When do you plan to? And feel free to correct me if I've misstated any of the facts.

Dr. FLETCHER. Mr. Barton, I think you are on track. We have some more homework to do. How much of that could be done, as far as the language of the bill is concerned, I'll have to leave to you. But we do have to look at those three items that I indicated, what was the incremental cost and so forth. We do have to present to you our best estimate of the full cost of the space station as currently configured. We expect to finish the first part of that, the three remaining elements from the Ray Hook study, sometime early in November. We expect to give you our best estimate of the full cost of the whole thing sometime like mid-January.

Now how that fits with the language of your bill I don't know. It's conceivable to me that there are ways, without spending any money, that we can go ahead on this, but we'll have to have further discussion with you and your staff. But you're quite right, we haven't finished all of the things that——

Mr. BARTON. Well, we're willing. I think the entire committee is willing to work with your associates and subordinates, and I do think you all made a good faith effort. I want to—you know, I don't think anybody's—there was a feeling earlier on that you weren't real interested in cooperating, and I think you've overcome that. And I want to again commend you for that.

But I do feel like that what has been presented today, while on the surface is no problem, it doesn't comply. And I would hope that you do comply.

I guess I have a technical question for Mr. Stofan. You talk about creating a unique exhibit that's going to handle some of the hab jurisdiction between—the hab module jurisdiction between Johnson and Marshall. I wish you would, if you haven't already, explain that to me and the rest of the committee, exactly how that's going to work, and how the jurisdictional lines will be drawn.

Mr. STOFAN. OK. There will be a clause in a contract we call an exhibit that will be—and it will be in the contract that is managed by Marshall. This exhibit, it's like a contract within a contract. The exhibit will be managed contractually and technically by the Johnson Space Center with a schedule and with the money associated with it to do the manned outfitting of the hab module. As long as they stay within the schedule and the cost that is prenegotiated, they have total control over the technical and delivery of that hardware—and check out of the hardware.

If it gets to the point they want to change the schedule for some reason or the cost exceeds what was negotiated in the beginning, they would go back to Marshall and then come back to me and say we want—we need more money or we need more time. But when the final module is sold off——

Mr. BARTON. And what does that mean, sold off?

Mr. STOFAN. When the Government accepts the module from the contractor, there would be people from Marshall and people from

Johnson that would sign off the paper that says the Government accepts this totally checked out integrated module from the contractor and indeed it's ready to ship to the cape.

Mr. BARTON. Well, to simplify all that to a layman's language that I can understand and the people in Houston can understand, having said all that, is the work that was being done in Houston still going to be done in Houston——

Mr. STOFAN. Yes.

Mr. BARTON. On the hab module?

Mr. STOFAN. Yes; absolutely. And I think, in fact, this addresses some of the points you made earlier that we didn't outline in detail in the testimony and haven't discussed so far. One of the things was concern of facilities because, or the concern there was we were transferring work from one place to another and we'd have to duplicate facilities. At this time with the decisions that have been made, we are not transferring any work from one center to another, so there will be no duplication of facilities at all. All of the testing, the test beds and things will be done—for the manned systems, will be done at Johnson with the existing facilities. There will be no facilities built at Marshall to do this at all.

So as far as the impact on facilities within NASA, there are none because we made sure the work stayed where the facilities were. So we have addressed that.

The other question on the module outfitting, had we done it the way we were going to do previously, and that is, to take the module—originally the Marshall contractor was going to partially outfit it, send it to the Johnson contractor who would finish outfitting it, and then send it to the cape. That's the original way we were going to do it. The way we're doing it now, having the one contractor, that saves $200 to $300 million, and that was in Dr. Fletcher's testimony. So we did run a cost analysis. The benefit of simplifying this to a one-contractor saved us from $200 to $300 million.

And again, we're not transferring people to any centers, and haven't transferred the job, so the facility question, there is no impact upon facilities.

So I think, most of what you wanted I think we can provide the answers to at this time.

Mr. BARTON. One final question and then I'll turn it back to the Chair.

Had the Congress not raised some red flags in the summer, would these cost reviews have been done anyway, and would the space station—I won't say redesign, but design change, which has evidently been made, baseline configuration changes, would they have been done? In other words, by us raising some red flags, could it be said that that caused you to go back and do some things you should have done anyway?

Mr. STOFAN. I think it would have to be said, Mr. Barton, that there were a number of red flags, one of which you raised. Because actually, Mr. Boland's committee, Appropriations Committee, also raised some red flags. Some of the astronauts raised some red flags. And it was quite—and we also weren't finished with the work packages. We hadn't really defined them that well. But certainly as we proceeded down the track, one of the red flags that you have

brought out was one of the guidelines. And as you recall, you said the work packages should be done by the center that had the expertise. And I think that was one of our guidelines, and that was your red flag.

Mr. BARTON. All right.

Dr. FLETCHER. I think you sharpened our focus appreciably.

Mr. BARTON. Good. Well, glad to hear us get a pat on the back. And with that I'll turn it back to the Chair.

Mr. NELSON. OK. We have just been informed that the NASA bill will be up immediately after the vote on the tax bill. So, fellows, get ready.

The tax bill will be coming up for a vote probably in about 15 minutes, and we expect two votes on the tax bill, and then the NASA bill will be up immediately thereafter. And we have completed general debate last night, so we're just going into the amendments. But to my knowledge, we have all of that worked out ahead of time, so we shouldn't be on the NASA bill that long.

OK, let me just do some cleanup here, Dr. Fletcher. On the question of crew safety and emergency return, what do you think is the average response time you would have to have to launch a shuttle that you did not preplan? In other words, you've got an emergency up there on the station, we've got to get a shuttle up to rendezvous—what is your average response time?

Dr. FLETCHER. You know I'd have to be guessing, and probably John Aaron or somebody that's had a little more experience with that sort of thing could answer. But if it's an emergency and we had a shuttle on the pad for some other purpose, that response time could be pretty short. It's not going to be, however, hours, or even days. It might be a week or two to reconfigure it for a rescue mission, but it would certainly be shorter than the normal response time that we take to launch a shuttle if one was on the pad. And I would guess we would want one on a pad at nearly all times when there are people up unattended at the space station.

Somebody may have a better answer than that. John?

Mr. AARON. No; that's a good general answer. We've looked at all the various places that a shuttle or orbiter might be in the flow process, and in the worst case, and I'll start with that one, an absolute worst case it may be up to 45 days if you catch it just wrong. Certainly in the medium or average, it could be in the neighborhood of 28 days; even sooner if you catch it just right. I think that's a key aspect of the safe haven in that architecturally we've added zones of safety within the space station modules themselves, and by having multiple modules and multiple systems in the architecture, you put those two together, allows you to retreat from zones of the space station into other zones until the shuttle can arrive. And that is a basic safety concept that we have today, in addition to the study we're doing on whether or not in addition to that what are the advantages of an additional crew rescue vehicle from an emergency standpoint, which we haven't completed our study.

Mr. NELSON. All right. Dr. Fletcher, you are, then, studying the possibility of a return vehicle that would be sitting up there on the station?

Dr. FLETCHER. Yes; in fact, Ray Hook's group addressed the problem of not what should the rescue vehicle be, but could one be ac-

commodated on this configuration when and if it were developed. And that was addressed and it can be done. But the actual rescue vehicle hasn't been decided upon yet.

Mr. NELSON. Now, of course, the cost of that rescue vehicle would not be an item within the $8 billion?

Dr. FLETCHER. Our costs aren't that refined yet. I think Mr. Stofan would say yes, it is not included.

Mr. NELSON. OK. Tell me, the fact that you've got the modules generally in the center, does that affect the Earth observations? Does it cut out some of your view, both of the Earth and out in space, from the modules?

Mr. STOFAN. The modules are located in the center to get a low gravity, a microgravity environment, so that's—to conduct the low-gravity environment, that's the preferable place, the best place to have the modules. It does obstruct the view somewhat from the modules, but that's why we have the dual keel and the upper and lower structure is to attach instruments that have an unobstructed view looking out and an unobstructed view looking down at the Earth.

Mr. NELSON. All right. Tell me about, now, you're going to be doing a lot of the science in and around these modules. And yet that's at the same place where you are likely to have a more contaminated environment. Tell me about your planning there.

Dr. FLETCHER. Mr. Chairman, there are many kinds of scientific experiments. The best place for doing Earth observations, as Mr. Stofan pointed out, is at the bottom of that dual-keel configuration. That doesn't mean you can't do Earth observations from the central platform, itself, and we probably will be doing some. And yes, I think your observation is correct that when that keel is in place it will inhibit the view of the Earth observation system. I don't think, however, contamination in that case will be a problem with the Earth observation system.

Where the contamination becomes a problem is on the upper part of that keel when you're looking at the astrophysics and astronomy experiments. They also need to be at some distance from the hab and lab modules. I doubt if we're going to do, we may do some solar physics experiments from the central part of that configuration, but the real sensitive astrophysical experiments probably would not be done until you get that upper part of the dual keel in place.

Now I'm just guessing at that, but I would guess the astronomers would want to get as far away from the habitability module as they could.

Mr. NELSON. In the interest of time I'm going to send you a series of questions for technical information, such as by what flight will you have the first star-pointing instrument, and so forth and so on. We'll send that to you.

In this new baseline configuration, Mr. Stofan, have you arranged it so that more of your verification and checkout operations can be done on the ground——

Mr. STOFAN. Yes; we have.

Mr. NELSON [continuing]. In order to reduce the EVA?

Mr. STOFAN. Yes; we have.

Mr. NELSON. How many annual hours of EVA did you envision under the old system as now under the new baseline?

Mr. STOFAN. John, do you remember the hours?

Mr. HOOKS. The EVA is approximately half in the construction phase of the space station that's done out of the shuttle and in terms of the numbers of hours that are required for the space station construction itself. Now the upper and lower keels are constructed out of the space station, and by—one of the things that hasn't been mentioned here is that we're going to deployable utilities as opposed to the erectable ones that we had before. That saves about an additional 50 percent of the EVA time. I'd have to give you the actual figures per year for the record. I don't have them at my fingertips.

Mr. NELSON. To your knowledge, any of you four gentlemen, is the concern that was expressed in Gordon Fullerton's study, has that been answered with your reconfiguration?

Mr. STOFAN. Gordon Fullerton was a member of my executive committee overviewing this entire process. And we went around the table at the end and each one said they were satisfied with what had been done, and Gordon also gave his blessing to what we're doing.

Mr. NELSON. All right. Tell me this, since you're not now going to complete the upper and lower boom structures until very late in the assembly, are you going to be in a position where you can assure this committee that still you're going to be able to complete those upper and lower boom structures within the $8 billion?

Dr. FLETCHER. Mr. Chairman, that's the $64 question. I can only answer I hope so because that depends on what answers we come up with next January. I would hope that we could complete the full configuration and that the cost would not be out of bounds with that $8 billion. We don't really have a precise answer to your question at this time, Mr. Chairman.

Mr. NELSON. Are there any other questions from the committee?

If I understand, am I correct, staff, that this is a quorum call? This is a live quorum call? OK.

I just want to make a couple of closing comments here, Dr. Fletcher. First of all, we want to thank you, from this committee. It's obvious that your team has done a lot of hard work, that you've done it in preparation to come here to try to settle down some of the concerns that the committee has expressed, and those concerns have been real ones. We think that your new managers have responded well to your request and to the request of this committee. We think this presentation that you've made to us represents a significant maturation in NASA's thinking about the space station. It's much clearer to us now what will be required to reach IOC.

Now you've heard the comments here. It's clear that this subcommittee intends to be all the more vigilant in ensuring that this program ends up meeting the needs of science and commercial users. Certainly we all worry about the budget pressures, possible accidents, or other events that might freeze the station assembly at a stage that would not allow it to achieve the scientific usefulness that we all envision. And so in our committee views accompanying

the NASA authorization bill we have emphasized the importance of attached payloads early in the assembly sequence.

Now I intend to ask the NASA Advisory Council to review the science mission baseline which your new assembly sequence will allow, and then for them to report back to us with their insight as to how it will meet the needs of science. By the same token, we want to fund the payloads that can use the station in an optimum manner.

Now another matter that has been expressed here of concern to this committee is that we adequately plan for station operations with a view toward minimizing the operational cost. I commend you on establishing your operations task force. I want to make absolutely sure that the results of this task force feed directly into the RFP, and that's why I asked that series of questions.

So we expect from the response of you to my questions that we have the assurance that you'll give this matter the same attention that you did in the attention that you gave to the Langley exercise. And I want to ensure that this task force makes a timely and useful input. And certainly that's going to be a long-term benefit to you in your RFP process.

And finally, the subcommittee is very interested in the role of the heavy-lift vehicles and how that might play into the Station Program and the Space Program in general. We look forward to your final report and to additionally make mention of this.

Do you have any further comments, any of you?

Dr. FLETCHER. I don't, Mr. Chairman.

Mr. STOFAN. No.

Dr. FLETCHER. I guess not.

Mr. NELSON. We thank you very much.

Dr. FLETCHER. Thank you.

Mr. NELSON. The meeting is adjourned.

[Whereupon, at 2:50 p.m., the subcommittee was adjourned, to reconvene subject to the call of the Chair.]

APPENDIX

SPACE STATION PROGRAM CONCERNS

Gordon Fullerton
6/20/86

65-920 O - 87 - 7

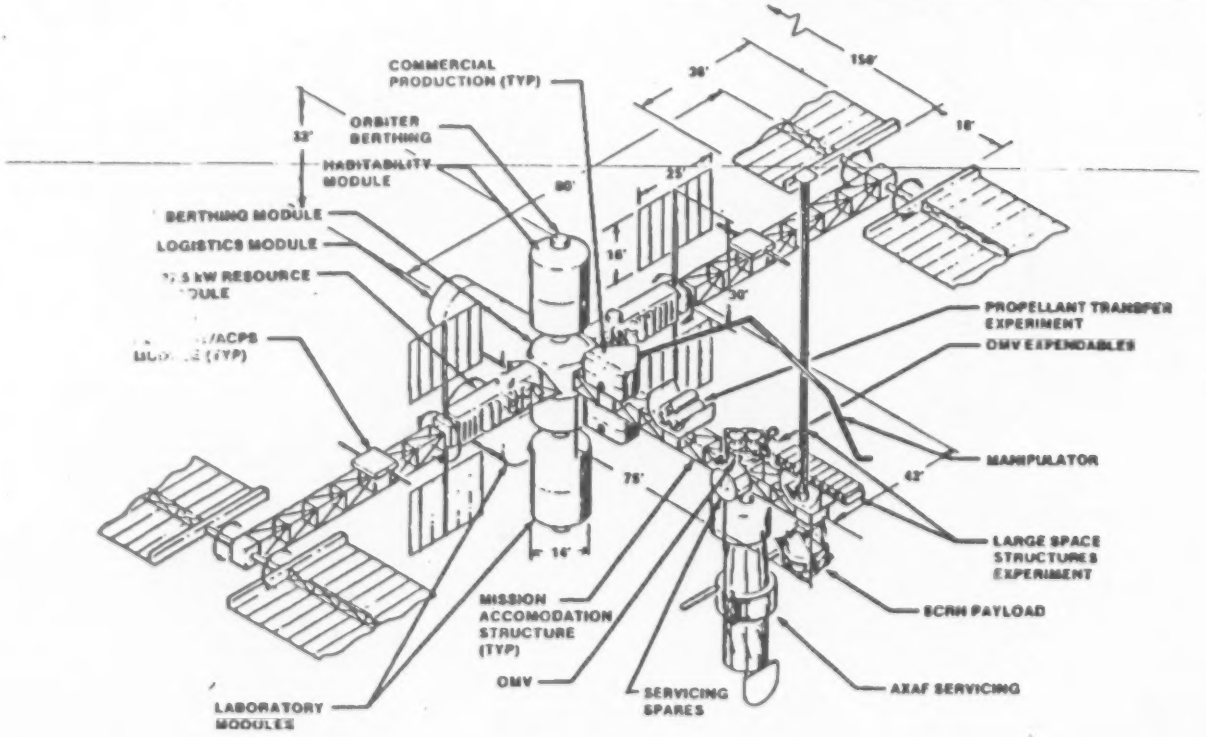
NASA

S-66-01275

Space Station Task Force

Concept Development Group

1983 Concept

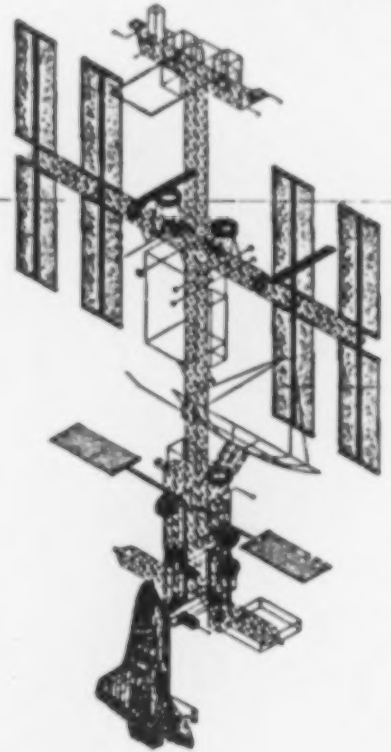


NASA

S-86-01276

Phase B RFP Reference Configuration

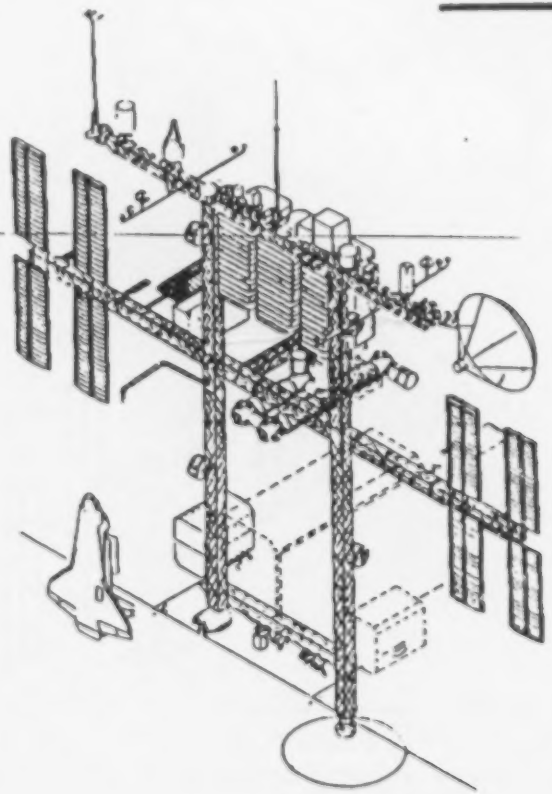
From 1984 Skunk Works



75kW
4 U.S. MODULES
CREW SIZE - 6
COST ESTIMATE $ 7.8 B

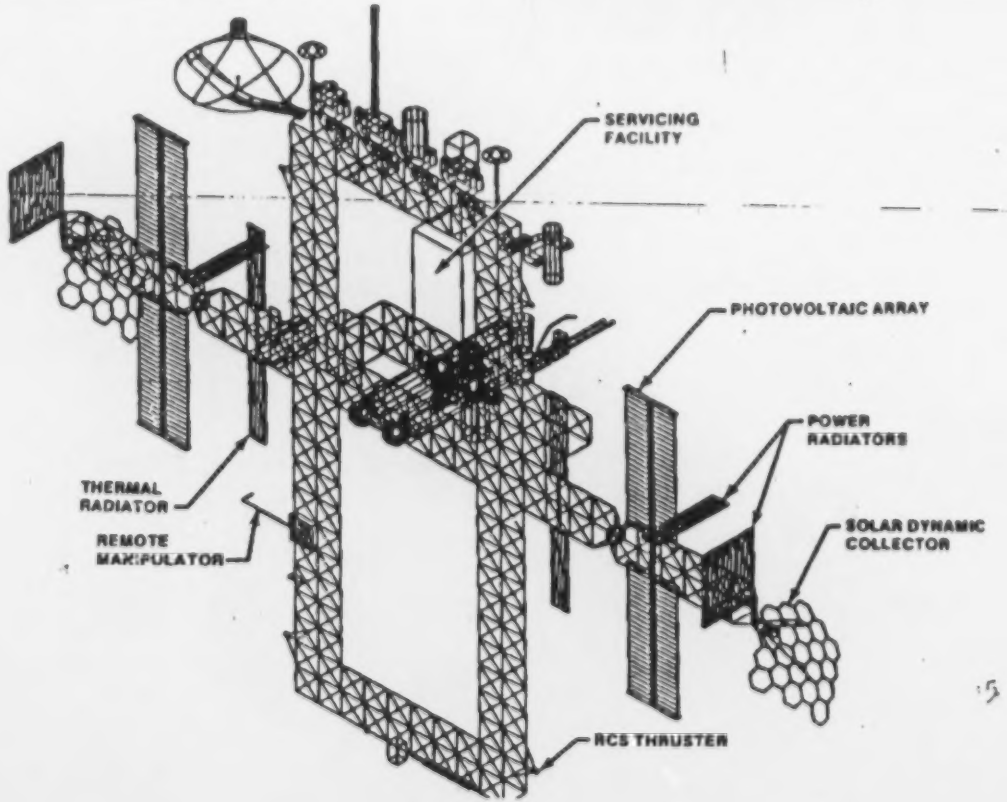
NASA
S-85-03029A

Dual Keel Space Station
RUR-2



NASA
S-86-01277

SRR Baseline Configuration
"Scrub" Results



HOW DID WE GET HERE?

- USER (CUSTOMER) REQUIREMENTS HAVE DOMINATED DESIGN
- USER REQUIREMENT LIST IS A "WISH LIST", NOT A REALISTIC LIST
- MAJOR INDEPENDENT EXPERIMENTS/FACILITIES DOMINATE – SMALL "HANDS ON" PROPOSALS LOST IN SHUFFLE

CURRENT PROGRAM POLICY

- STICK WITH "SCRUB" CONFIGURATION AS PHASE B RESULT (ALREADY ANNOUNCED TO PUBLIC)
- LOBBY FOR PROGRAM START IN '87 BUDGET
- WRITE PHASE C/D CONTRACTS TO ALLOW REGROUP/REDESIGN TO A WORKABLE CONFIGURATION

TECHNICAL CONCERNS

- NO LIFEBOAT
  - INSURING ORBITER AVAILABLE IS SEVERE OPERATIONAL CONSTRAINT WITH SMALL FLEET
  - SUSCEPTIBLE TO STS FLEET GROUNDING
- HABITABLE VOLUME LIMITED
  - RACKS IN LAB MODULE COVER WINDOWS
  - NO ROOM FOR 2ND SHOWER/COMMODE/PHS, SAFE HAVEN PROVISIONS
  - INADEQUATE SEPARATION OF WORK/EXERCISE/EATING AREA FROM SLEEP QUARTERS
  - WILL LEAD TO POOR MAINTENANCE ACCESS
- STS REQUIREMENTS UNREASONABLE
  - ASSEMBLY PHASE - 18 FLIGHTS TO IOC (14 ASSEMBLY + 4 LOGISTIC FLIGHTS)
  - STS WEIGHT LIMITED - MODULES OFFLOADED, 109 % REQUIRED
  - OPERATIONAL PHASE - 4 LOGISTICS RESUPPLY FLIGHT /YEAR FOR SS, PAYLOADS ADDITIONAL
- DEPENDENCE ON MOBILE MANIPULATOR
  - VERY COMPLEX MECHANICALLY, ELECTRICALLY
  - DEVELOPMENT COST HIGH
  - EVA CONTROL STATION
  - OPERATIONAL COMPLEXITY
  - MAINTENANCE -- CAN WE KEEP IT RUNNING?

- EXCESSIVE EVA FOR OPERATIONS
  - ASSEMBLY LONG, COMPLEX -- NEED 48 EVA MAN/HOURS PER STS MISSION
  - EVA/IVA EFFICIENCY FACTOR LOW (20:1)
  - EVA ONLY ACCESS TO MOST PAYLOADS
- MAINTENANCE DEPENDENT ON EVA
  - TOO MUCH CRITICAL EQUIPMENT OUTSIDE
  - ORU REPLACEMENT DELAYED UNTIL NEXT RESUPPLY FLIGHT
  - BASIC STRUCTURE, WIRE RUNS, PLUMBING NOT EASILY DESIGNED FOR REPLACEMENT/REPAIR EVA
  - EXCESSIVE CREW TIME REQUIRED DUE TO LOW EFFICIENCY OF EVA (CURRENT EST. 2138 HOURS IVA, 391 HOURS EVA + OVERHEAD PER YEAR FOR PLANNED MAINTENANCE)
  - CORRECTION OF DESIGN ERRORS MAY NOT BE POSSIBLE
  - UNPLANNED FAILURES MAY NOT BE FIXABLE AT ALL

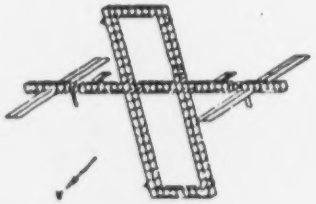
ALL THE ACTIVITIES THAT NOW GO ON IN THE OPF BETWEEN STS FLIGHTS MUST BE DONE BY THE SPACE STATION CREW ON ORBIT

Fundamental Station Elements are Assembled in Four Flights — Old Baseline

FLIGHT 1
- ELECTRICAL POWER, CONTROL, COMMUNICATIONS DMS, RCS

FLIGHT 2
- ELECTRICAL POWER, MRMS, CENTRAL RADIATOR

FLIGHT 3
- UPPER KEEL & BOOM, RCS, MODULE KEEL, STATION INTERFACE ADAPTER



FLIGHT 4
- COMPLETE STRUCTURAL ASSEMBLY
- 2nd CENTRAL RADIATOR JOINT
- CHANGE FLIGHT ORIENTATION
- RELOCATE RCS
- PATHFINDER PAYLOAD

CAPABILITIES:

POWER: 25 kW (WHEN FLOWN FOR MAXIMUM POWER)

GN&C: 4 CMGs (FULL IOC CAPABILITY)

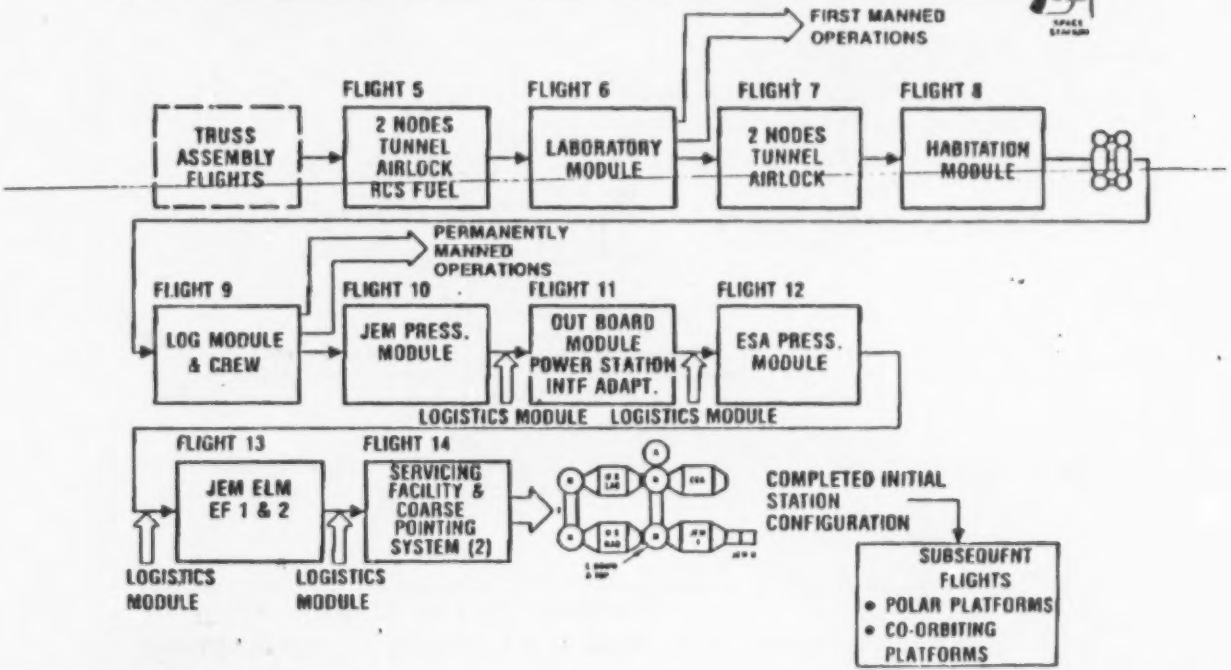
RCS: 4 MODULES IN PERMANENT POSITION (FULL IOC CAPABILITY)

DMS: DATA FOR MONITORING SPACE CRAFT FUNCTIONS

COMMUNICATIONS: LOW RATE TDRSS
GPS POSITION DATA
SINGLE FRAME VIDEO

COOLING: 20 kW

...national Modules are Used in the Basic Module Pattern



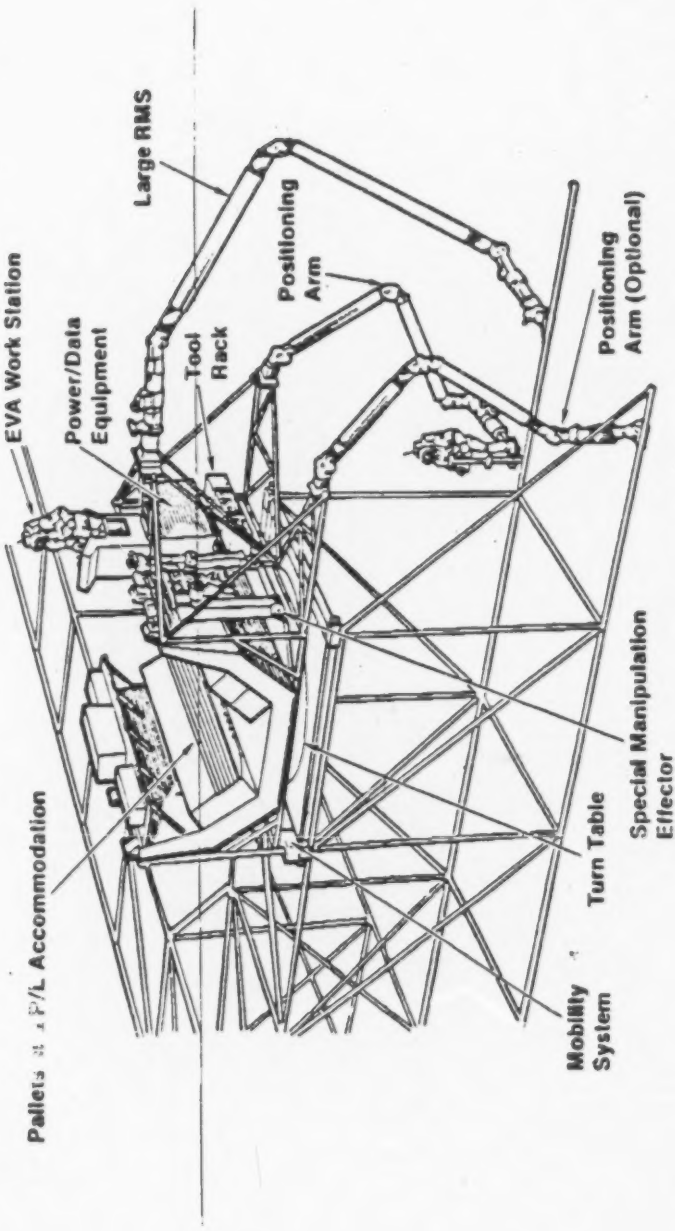
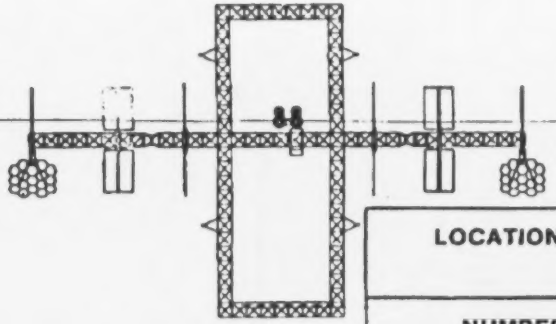


Figure 1-2. Mobile Service Center

NASA
S-86-01291

Over Half of the Distributed System Components are Outside the Modules



H, R, & T
GN&C
POWER, C&T, DMS

LOCATION OF DISTRIBUTED SYSTEM COMPONENTS ON SPACE STATION			
NUMBER OF SUBSYSTEM HARDWARE SUBASSEMBLIES	IN PRESSURIZED MODULES	ON EXTERNAL TRUSSES	TOTAL
PMAD	10	16	26
DMS	76	85	161
C&T	107	86	193
GN&C	2	37	39

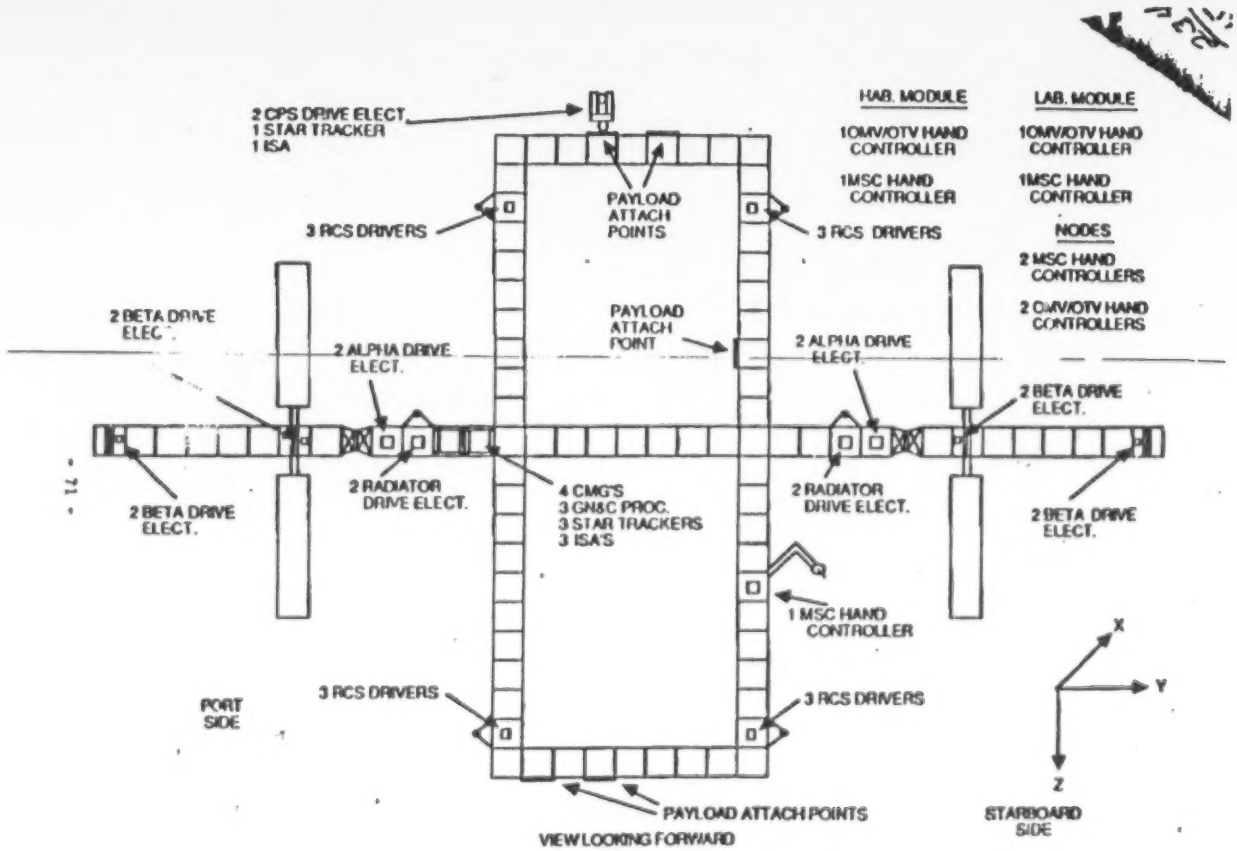
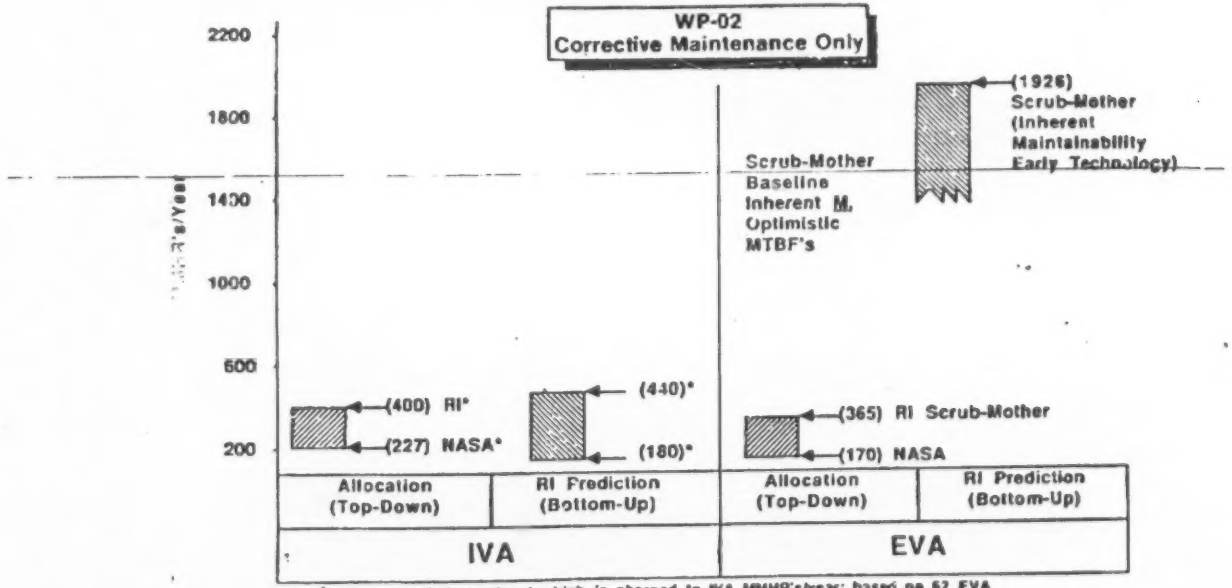


Figure 8.4.3-7. GN&C Equipment Location--Flight 9, Permanently Manned

NASA 3/86 Allocations and Scrub-Mother Preliminary Predictions Shows EVA Corrective MMHRs/YR to be Significant Issue



* Excludes EVA overhead which is charged to IVA MMHR's/year; based on 62 EVA excursions/year and 11 MMHR's/excursion (improved EVA maintenance); this value is 682 hours/year.

SUBJECTIVE CONCERNS

- MAN'S ROLE MINIMIZED
  - POOR ACCESS FOR MAINTENANCE
  - VISIBILITY FROM HABITABLE AREAS OBSTRUCTED
  - NO PROVISION FOR IVA "HANDS ON" ACCESS TO EQUIPMENT TO BE USED OUTSIDE
- PROGRAM MORALE POOR
  - PEOPLE DON'T "BELIEVE" IN THIS STATION
  - GREAT CONCERN THAT NASA IS MISREPRESENTING WHAT WE CAN DO TO CONGRESS, PUBLIC
  - STRONG FEELING THAT TO PRESS ON WITH INTENT TO CHANGE LATER IS POLITICALLY AND MORALLY WRONG

NASA HAS BEEN CRITICIZED SEVERELY RECENTLY FOR LETTING PROGRAM OBJECTIVES OVERRIDE GOOD JUDGEMENT –IS IT HAPPENING AGAIN?

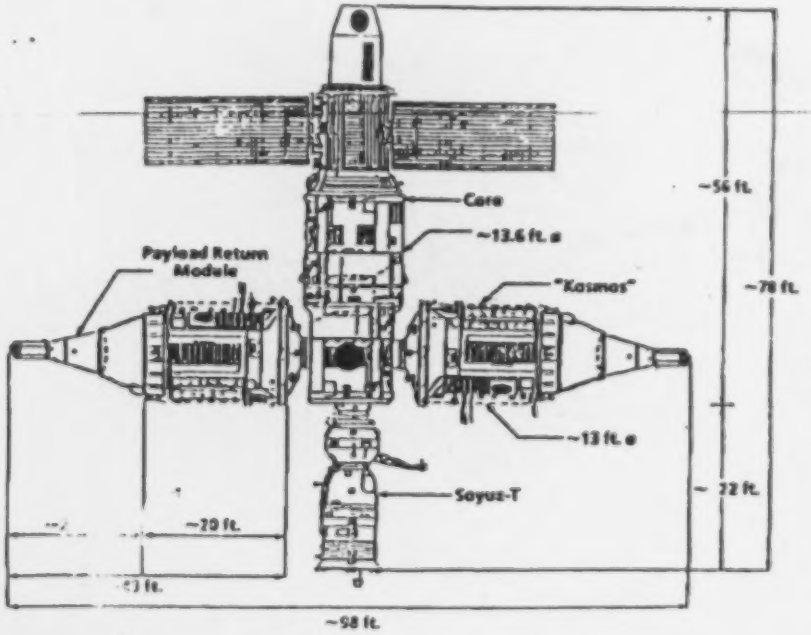
WHAT SHOULD BE DONE

REDIRECT PHASE B STUDY (OR AT LEAST ORDER A STRONG PARALLEL EFFORT) TOWARD:

- NATIONAL HEAVY LIFT (~ 150,000#) ELV
  - SHUTTLE DERIVED OR NEW
  - JOINTLY WITH DOD
- CORE SS -- 1 OR 2 HEAVY LIFT LAUNCHES
  - NOT VOLUME LIMITED
  - ASSEMBLED/CHECKED OUT PRELAUNCH
  - ALL CRITICAL SYSTEMS INSIDE
- ATTACHED INTERNATIONAL MODULES
- TRUSS STRUCTURE ADDED AS REQUIRED BY ACTUAL NEEDS

SOVIET "MIR" (PEACE) SPACE STATION COMPLEX

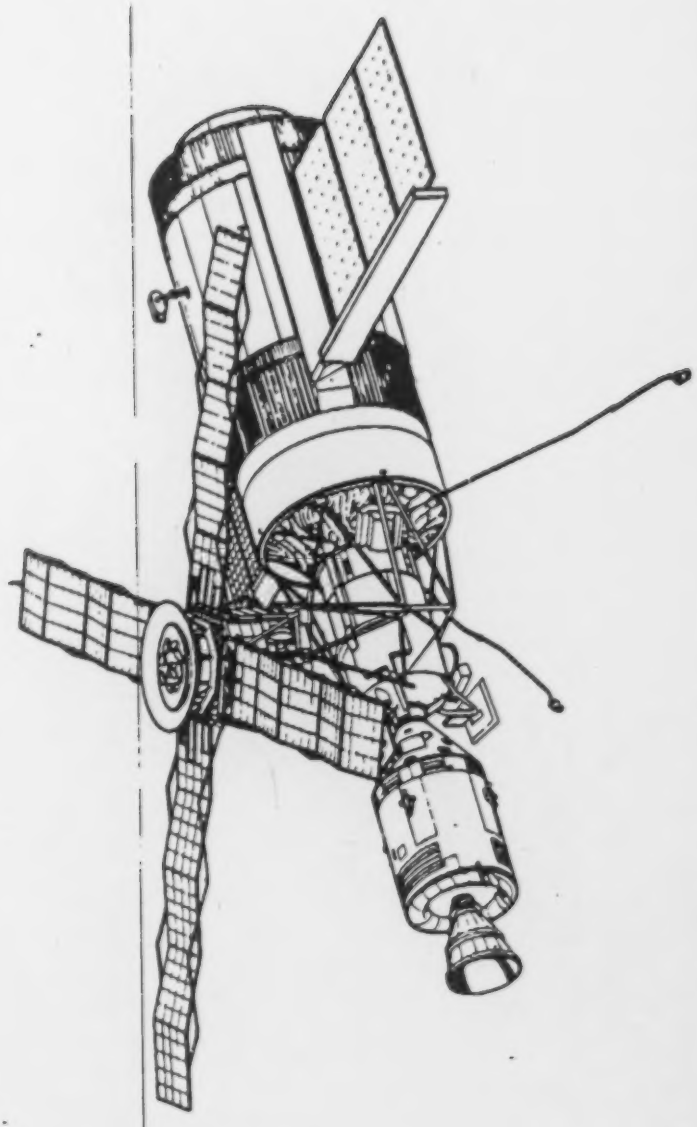
(Core launched February 20, 1986)



ESTIMATED FULL-UP CHARACTERISTICS

Modules:	?
	• 1 Core (6 docking ports)
	• 4 Kvants
	• 1 or 2 Soyuz-T Crew Transport/Escape Vehicles,
	• and/or 1 Progress Resupply Vehicle
Power:	23 kw e
Weight:	235,000 lbs.
Length:	78 ft.
Width:	98 ft.
Crew:	3-6
Launches:	?
Pressurized Volume:	~510 m³
Dedicated Modules:	1. Technological Production & "Shop"
	2. Astrophysics
	3. Biological Research
	4. Medical
Other Additions:	• Private Crew Compartments
	• Enhanced Communications
	• Enhanced Automation

OSS-1416



NASA-S-73-003-S

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July 14, 1986

Hon. James C. Fletcher
Administrator
National Aeronautics
and Space Administration
Washington, DC 20546

Dear Dr. Fletcher

Upon returning from the July 4 Congressional recess we received your letter of June 30 informing us of your proposal for restructuring the management and organization of the Space Station program. The proposed changes are of a substantial nature and will have a far-reaching effect on NASA's management of its human and budgetary resources. We note with concern that your letter coincides with the public announcement of the proposed changes. As we have not discussed these matters, we would not want you to assume that the proposed changes have our support. We might add that this lack of coordination with this Committee extends a disturbing pattern which we would very much like to remedy.

While it is clear that management changes are needed, they should be carefully considered by all involved in running the program. We are informed that the full implications of the proposed changes cannot be determined until Mr. Stofan assumes his new position and makes decisions on details of implementation.

Accordingly there is no way for us to approve these proposed changes. Please avoid implementing them until we have reviewed the implications of this plan and indicated our satisfaction with your proposals.

We look forward to hearing from you and Mr. Stofan.

Sincerely,

Bill Nelson

BILL NELSON
Member of Congress

Bob Walker

ROBERT S. WALKER
Member of Congress

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

Office of the Administrator

OCT 3 1986

Honorable Bill Nelson
Chairman
Subcommittee on Space
Science and Applications
Committee on Science
and Technology
House of Representatives
Washington, D. C. 20515

Dear Mr. Chairman:

Enclosed is a report submitted in response to the direction contained in H.R. 5495, the FY 1987 NASA authorization bill, as passed in the House of Representatives on September 25, 1986, relative to Space Station technical work assignments. Section 101 of that bill directs that NASA submit to the Committee a report justifying any proposed Space Station work package "reassignments" in terms of anticipated costs and benefits, management factors, and impacts on facility and personnel resources.

The report submitted herewith details the management rationale which underpinned my June 30 work package decisions, the management alternatives which were considered, and assessments of the suitability of each alternative in terms of cost, management factors, institutional capabilities, and manpower. It further outlines the results of the refinement of the work package alignment which emerged in conjunction with the Critical Evaluation Task Force (CETF) exercise recently completed at Langley Research Center. While I have requested that additional analysis be undertaken on certain issues relative to the Station design review by the CETF, I expect virtually no modification of the work package alignment as a result of that further analysis. I believe that you will find that the work package alignment, as refined, represents an optimal approach in terms of assuring efficiency and economy of management, clear accountability, and preservation of Center expertise.

I believe that this management analysis supplements the progress we have made in resolving the Station configuration through the CETF exercise and the refinement of work package alignment. As I reported to you on September 25, the CETF exercise has produced an improved configuration which reduces extravehicular requirements and adds habitable volume, as well as a revised assembly sequence which assures early science capability and meets projected Shuttle launch capacity. The work package assignments have been refined in a manner which both

draws upon the expertise of the Johnson Space Center in manned spacecraft systems and that of the Marshall Space Flight Center in orbital laboratories, and preserves contractual accountability throughout the processes of development, validation, and checkout of the Space Station system. NASA is now prepared to initiate the procurement process for Space Station development with an improved design and a streamlined management structure.

I believe this report meets the requirements as outlined in H.R. 5495, and look forward to your continued support for initiation of the Space Station development effort as we enter the new fiscal year.

Sincerely,

James C. Fletcher
Administrator

cc: Honorable Robert S. Walker

Enclosure

NASA
National Aeronautics and
Space Administration

SPACE STATION MANAGEMENT: AN ANALYSIS OF WORK PACKAGE OPTIONS

SUBMITTED TO THE
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

IN FULFILLMENT OF THE REQUIREMENT
IN SECTION 101 (l) OF THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AUTHORIZATION ACT, 1987

OCTOBER 3, 1986

INTRODUCTION

The following report on Space Station work packages is submitted to the House Committee on Science and Technology in response to the direction contained in H.R. 5495, the FY 1987 NASA authorization act, as passed in the House of Representatives on September 25, 1986. Section 101 of H.R. 5495 directs that NASA submit to the Committee on Science and Technology a report justifying any proposed Space Station work package "reassignments" in terms of anticipated costs and benefits, management factors, and impacts on facility and personnel resources.

The report is organized to respond specifically to the legislative direction:

I. Management Overview discusses NASA's overall rationale for organizing the management of the Space Station Program along functional, work package lines based in individual NASA development centers.

II. Management Factors outlines the Space Station management review conducted by Gen. Sam Phillips, the rationale for enhancing contractor accountability and the alternative management approaches to work package alignment which have been assessed.

III. Current Approach details the results of the Critical Evaluation Task Force review of the Space Station configuration recently completed at the Langley Research Center, and the refinement of the Phillips work package baseline which emerged in conjunction with the review.

IV. Anticipated Costs and Benefits and Impacts on Facility and Personnel Resources outlines the assessed cost, benefit, and institutional implications of the various work package options evaluated.

MANAGEMENT OVERVIEW

In order to utilize fully NASA expertise which is spread among the various NASA field centers, the agency allocated the task of Space Station definition and design to four centers: the Goddard Space Flight Center in Greenbelt, Maryland; the Johnson Space Center in Houston, Texas; the Lewis Research Center in Cleveland, Ohio; and the Marshall Space Flight Center in Huntsville, Alabama. Each center would manage a portion of the task. Each center would also manage contractors, selected competitively, that would carry out its assigned share of the work. The Space Station program thus would involve a number of U. S. aerospace firms, avoiding a dependency upon a single prime contractor. For a program expected to last well over twenty years, such a dependency would not be in the best interest of the government. And by utilizing several NASA installations, the Space Station would be an effective vehicle for the strengthening of NASA's technical and managerial expertise.

An alternative approach, considered but rejected by NASA, was to compete the entire Space Station program as a single package. This would have resulted in a prime contractor, a single company responsible for the design of all Space Station systems. This company would then engage a number of other companies, or subcontractors, to assist it. A corollary of this approach would be the selection of one of the NASA centers as lead center.

The portions of Space Station definition and design allocated to the NASA centers are termed "work packages." The work package allocation was functional in nature. The Goddard Center was responsible for attached payloads, servicing of payloads, and the Space Station's free-flying, unmanned platforms. The Johnson Space Center was responsible for manned systems, structure and assembly, and a number of key systems such as data management and navigation. The Lewis Research Center was responsible for the Space Station's power system. The Marshall Space Flight Center was responsible for the common module, certain outfitting and the propulsion system.

For a program like the Space Station, the devices for assuring systems integration and accountability are central to effective management. Systems integration is the function that assures that the many subsystems of an engineering project -- be it an automobile, a ship, or a spacecraft -- fit together and function as a single unit. For a system as technically complex and diverse as a Space Station, it is of crucial importance. The Space Station work packages brought substantial technical and management talent to the individual Station projects. The question of how these four projects were to be merged into a single

program was answered by the establishment of a separate office, and level of management, tasked to perform this function. This office was located at the Johnson Space Center and was responsible for the Space Station's overall systems architecture. Its director was the "program manager," reporting to the Associate Administrator for Space Station. The four work package offices at the centers reported to this office. Because it had both a Space Station project office and the systems integration office, the Johnson Space Center was in effect the "lead center" for the program. As part of the recent overhaul of the Space Station program management, and consistent with the recommendations of the Rogers Commission to strengthen NASA Headquarters, the systems integration function will now be managed by the new Space Station office in the Washington, D.C. area. Johnson's work package responsibilities remain with the Center, at Houston. As a management option the lead center approach has been abandoned because of difficulties arising when one NASA center is tasked to allocate resources among itself and other centers.

Accountability is central to effective program management. It is the means by which technical, schedule and cost targets can best be met. In the initial work package allocation, accountability was to be functional in nature. Each of the four centers (and thus their contractors) were in theory responsible for certain Space Station functions: servicing, power and its distribution, outfitting etc. But the natural tendency to focus on hardware and the lack of definition of divisible Space Station functions led to considerable overlap and to some confusion.

Some of the overlap was deliberate. During the first half of the year the Space Station program was early in Phase B, focusing upon definition. Preliminary design had not yet begun. Overlap was deemed appropriate at this early stage to stimulate creativity. For example, much of the outfitting of the modules was assigned to Goddard, Johnson, and Marshall. NASA had always intended to rectify these overlapping responsibilities and had begun to do so in May.

At this time the Space Station program office engaged the services of General Samuel Phillips to review the program's overall management structure. General Phillips is a former Apollo program manager with extensive aerospace management experience in the private sector. His mandate included work package responsibilities and his recommendations formed the basis for NASA's Space Station management actions in the summer of 1986. General Phillip's report is discussed in the next section of this report.

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MANAGEMENT FACTORS

As noted above, Gen. Samuel Phillips was asked earlier this year to review the organization and project responsibilities of the Space Station Program. His specific objectives included a review of the management structure, the distribution of work among the field centers, and NASA's plans for in-house system engineering and integration. To accomplish this review, Gen. Phillips formed a committee of experienced managers with extensive background in the aerospace industry and knowledgeable of NASA and how the agency conducts its business. The committee process involved lengthy interviews at NASA Headquarters, the Program Office at Johnson Space Center, and the five field centers involved in the Space Station Program development. At each field center, they visited the Center Director and the Space Station Project Office and then spoke independently with each of the Phase B contractors. Upon return to Washington, they met again with Mr. Philip Culbertson, NASA General Manager, and Mr. John Hodge, then Acting Associate Administrator for Space Station; and they also met with Dr. Burton Edelson, Associate Administrator for Space Science and Applications, and his staff as well as with Adm. Richard Truly, Associate Administrator for Space Flight, and his staff. On the basis of these numerous interviews and a careful review of relevant documents, Gen. Phillips and his colleagues developed conclusions and formulated recommendations that were presented to Dr. Fletcher on June 26, 1986.

The Phillips committee determined that the management structure in place when the review began simply would not work and that, unless changes were made, the Space Station program would continue to incur difficulties. The committee was also concerned that the existing division of work among the field centers diffused accountability and that, if clear contractor accountability were not maintained, the development process would be difficult to control, and the validation, check-out, and operation of the assembled system would become tangled and arduous processes. The Phillips Committee sought to improve the efficiency and economy in the design, development, test, and integration of the Space Station by recommending that all the people, pieces, and organizations be incorporated in a management structure that had clear and straight forward lines of authority.

The recommendations to Dr. Fletcher focused on two areas; first, on correcting the management structure, and second, on improving the distribution of work among the field centers to maintain accountability and to better assure product quality. Regarding the management structure, four basic recommendations were made:

- Establish a Space Station Program Management Office at Headquarters headed by a strong program director;
- Provide technical support to that office through the acquisition of a contractor highly competent in systems engineering and analysis and who would command the technical respect of Field Center personnel;
- Establish a branch office in Houston for system integration; and,
- Provide line direction of the Field Center project managers directly from the Headquarters Program Management Office.

The recommendation on the distribution of work among field centers (work packages) was driven by the principle of maintaining contractor accountability. Such accountability is essential to cost control. The principle led in the direction of segmenting the program into clearly definable major deliverable items that could be integrated and checked out independently, and of assigning the entire design and development responsibility for each deliverable item to a single contractor. The only deviations from this principle were driven by the economic considerations of developing and operating end-to-end systems, such as data management, which would have similar components in each deliverable item. To avoid the added expense of supporting independent design and development of like items by two or more contractors, it was determined that a single common source should be selected for each end-to-end system and the appropriate components would be delivered to the developer of each deliverable item.

In consideration of the above, the Phillips Committee recommended the following assignments:

- All pressurized modules, nodes, and tunnels to the Marshall Space Flight Center;
- The truss and its associated systems to the Johnson Space Center;
- The platforms and servicing facility to the Goddard Space Flight Center; and
- The power modules and the power management system to the Lewis Research Center.

These recommended assignments resolved issues regarding overlap and duplication of work by placing the Marshall Space Flight Center contractor in the role of the single module developer and the single module integrator for the program.

Because the assignment of the habitation module to Marshall caused a skill mix problem within NASA, Gen. Phillips and his committee recommended that Johnson provide technical direction to the Marshall contractor for the design and development of man systems. This recommendation solved the NASA skill mix issue and made optimum use of the existing institutional facilities and test beds, without diffusing the accountability of the Marshall contractor for producing a fully checked-out habitation module.

In arriving at this recommendation, several other options were considered to resolve work package issues. The option with the least change to the then existing center hardware assignments consisted of eliminating the overlap between center assignments and of proceeding with the work package structure established at the beginning of Phase B. This option would have required the Marshall contractor to build "common module" structures, perform a preliminary outfitting of these modules with equipment provided from the Johnson and Lewis contractors, and then ship a module to the Johnson contractor where it would be outfitted with the habitation equipment. Marshall would outfit the laboratory and logistics modules. Furthermore, because some habitation equipment must also be located in the laboratory module to satisfy the redundancy requirement, that equipment would have to be shipped from the Johnson contractor to the Marshall contractor for installation in the laboratory module. This option was characterized as the single module developer with dual module outfitters and the laboratory module assigned to Marshall. It was rejected for a number of reasons. The many hand-offs of equipment from one contractor to another diffused contractor accountability. The plan to have two contractors outfit separate pressurized modules unnecessarily increased the cost of providing handling equipment, test fixtures, and simulators and of writing procedures. In addition, the vast amount of equipment being exchanged by contractors in this option was judged to pose a severe schedule threat. A cost impact of $200 to 300 million above the baseline Phillip's recommendation was estimated to be associated with this dual module outfitter option.

A variation of the above option, characterized as a single module developer with dual module outfitters but with the laboratory module assigned to the Johnson Space Center was also examined. This option proposed to have all the systems and the outfitting of the laboratory and habitation modules performed by Johnson, while assigning the design and development of all module structures to Marshall along with the responsibility for outfitting the logistics modules. The outfitting of modules was split between two contractors, resulting in a similar cost inefficiency ($200 - 300 million) as in the previous option. It also required an extensive exchange of hardware between contractors, with

system components delivered by the Johnson contractor to the Marshall contractor and module structures delivered by the Marshall contractor to the Johnson contractor. Furthermore, although this option capitalized on the Johnson expertise, it failed to capitalize on the capabilities acquired by Marshall in developing this nation's previous Space Station, SKYLAB, and in working with the European Space Agency (ESA) to develop and operate the current STS Space Laboratory, Spacelab.

Another option considered the assignment of the habitation module to Johnson and of the laboratory and logistics modules to Marshall. This option proposed totally independent developments at each center, and is described as the dual module developer and dual module integrator option. The option was rejected because of the unnecessary cost burden which would have been required to support dual independent development of similar items at each center. This added cost burden was estimated at $900 million to one billion.

Thus, it can be seen that the costs of diffuse accountability are due to increased requirements for equipment testing and procedures as a result of multiple interfaces, and distributed contractual responsibilities as well as added schedule requirements. The benefits of enhanced accountability are largely based upon avoidance of these costs. The recommendation made by Gen. Phillips minimized the amount of hardware hand-offs and maintained contractor accountability by assigning the responsibility for the development of the habitation modules, the laboratory module, and the logistics modules to a single contractor team. This single module developer and single module outfitter approach is the least costly option, providing the clearest lines of contractor accountability, while making the best use of NASA's center expertise and facilities.

CURRENT APPROACH

By July 1986, the Space Station program was situated to move forward. General Phillips and his colleagues had completed their review of Space Station organization and project responsibilities. A new Associate Administrator for Space Station had been appointed and a new Headquarters organization had been decided upon. Work package resolution was underway. And a "Baseline Configuration," an initial design to guide the preparation of the Request for Proposals (RFP) for the development competition and to focus Space Station preliminary design activities, had been established.

This configuration was the result of considerable analysis by NASA and industry, reflecting the completion of Phase B definition.

Concerns with certain aspects of the baseline configuration had arisen, in part because its transportation assumptions predated the loss of the Challenger. These concerns dealt with the frequency of Shuttle flights, the requirements for extravehicular activity, safety margins and the need for early payloads. At the same time, concerns had also arisen with the planned realignment of work packages. Combined, these concerns led the NASA Administrator in July to order an overall review of Space Station design and to reconsider the work package alignments. The testimony presented by the NASA Administrator to the Committee on September 25 reflected the results of this review.

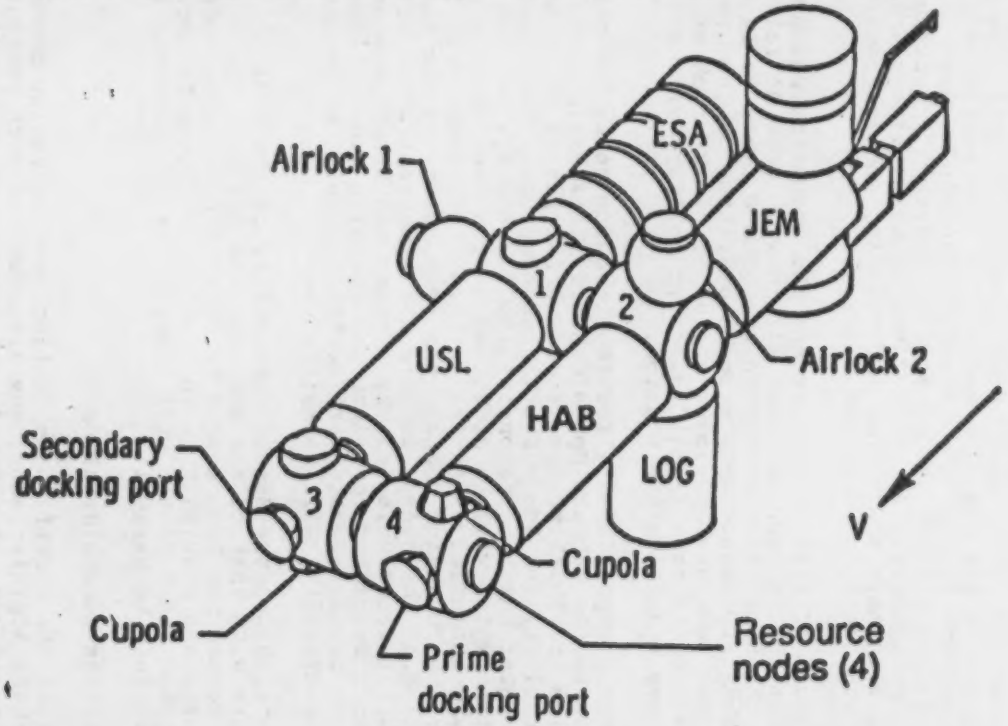
Design Review

To conduct the design review the Administrator established a Critical Evaluation Task Force composed of engineering experts from all the NASA centers. Located at the Langley Research Center, Hampton, Virginia, the Task Force addressed the concerns that had been raised regarding the baseline configuration. Specifically, the Task Force looked at transportation capability, flight assembly and checkout, operations, safety, and early user accommodation. The Task Force concluded the baseline configuration was essentially sound but recommended a revised assembly sequence and a modified pattern of pressurized modules.

One of the primary recommendations of the Critical Evaluation Task Force is the inclusion in the Space Station configuration of "Resource Nodes." These resource nodes are larger, outfitted versions of the pressurized nodes and tunnels which initially functioned simply as passageways connecting the laboratory and habitation modules in the baseline configuration. Four resource nodes will replace the four nodes and two tunnels of the baseline. Figure 1 on the next page illustrates the recommended module configuration with the resource nodes.

The proposed resource nodes resolve many of the concerns raised regarding the baseline configuration. For example, the resource nodes add about 4000 cubic feet of usable pressurized volume to the Space Station. This additional volume will house systems and subsystems that were previously located either outside on the Station structure or inside the laboratory or habitation modules. By moving subsystems inside the pressurized volume, the requirement for EVA for maintenance of the Station is significantly reduced, with a concurrent reduction in safety concerns and an increase in crew productivity.

PROPOSED MODULE CONFIGURATION



USL - U.S. Lab Module
HAB - Habitation Module
LOG - Logistics Module
JEM - Japanese Experiment Module
ESA - European Space Agency Module

OSS-2667
10/92/96

Offloading core Station systems from the laboratory and habitation modules to the resource nodes will free up volume inside the modules. For example, the primary command and control function will move from the laboratory to another node. In addition, major parts of the Station's core systems, i.e., communications and tracking, guidance, navigation and control, and data management, will move from the modules to the resource nodes. This relocation will remove systems requiring substantial amounts of crew activity from the habitation module, thereby improving the overall habitability aspects of the crew's living quarters. It will also make additional habitability and laboratory volume available for crew and storage.

As a result of this relocation and the resulting weight reduction in the modules, NASA will now be able to fully outfit the habitation module on the ground prior to launch. The laboratory module will also be outfitted on the ground except for some user payloads and experiments which will be supplied on the next flight following delivery of the laboratory module to the Station.

Management responsibility for the resource nodes has been assigned to the Johnson Space Center. This assignment maintains the Phillips Committee's principle of end item accountability for Space Station development. The Johnson Space Center has had responsibility for the systems and subsystems which will be contained in the new resource nodes and has substantial expertise in this area; therefore, it is appropriate to assign Johnson the responsibility for the outfitting of the nodes. Because the same contractor will be responsible for developing the systems and subsystems and for then integrating them into the resource nodes, hardware hand-offs between development contractors will be reduced and accountability will be maintained.

To capitalize on the design commonality of the node structure with that of the modules, the Marshall Space Flight Center has been tasked to build the resource node structures and provide them to the Johnson Space Center. The Johnson Space Center will provide the requirements for the structure to Marshall.

Work Package Reconsideration

As part of the recent Space Station program review mandated by the NASA Administrator, the alignment of work packages was reconsidered. A refined work package recommendation has been made to the NASA Administrator, who is comfortable with the proposal. This realignment was presented to the Subcommittee on Space Science and Applications on September 25, 1986.

Under this recommendation, responsibility for the laboratory module, habitation module, logistics module and the resource node structure would be assigned to the Marshall Space Flight Center. The external truss, distributed subsystems, EVA systems, airlock and resource node (except for the shell structure) would be assigned to the Johnson Space Center. Responsibility for Space Station platforms, attached payload accommodations, the robotic servicer, and NASA's role in servicing would be assigned to the Goddard Space Flight Center. The power system would be assigned to the Lewis Research Center. The Marshall Space Flight Center, through its contractor, would have overall responsibility for the Space Station laboratory and habitat module. In recognition of Johnson's unique expertise, the Johnson Space Center would have technical and contractual responsibility for the manned space subsystems, components and hardware of the habitat module. This would be exercised through a unique "exhibit" within the Marshall contract for the definition, design, development, test and delivery of those manned systems. Such items are specified in a Memorandum of Understanding between the two Centers which outlines each Center's responsibilities. The exhibit would maintain Marshall's - and its contractors - overall managerial responsibility. Contractors and subcontractors working on the habitat's manned space subsystems would report to the Johnson Space Center which will retain in Houston responsibility for related R&D, test beds and training.

A similar exhibit will be established in the Johnson contract. Technical and contractual responsibility for the engine elements of the Space Station's propulsion system would rest with the Marshall Space Flight Center, in recognition of its expertise in that field.

There are no plans for personnel shifts between Marshall and Johnson. Test beds, training facilities and research and development activities related to manned systems would remain at the Johnson Center. The proposed work package alignments envision stability in civil service personnel at both Centers.

The management implications of this work package alignment are significant. The Johnson Space Center would remain the focus for manned space flight activities. The Marshall Space Flight Center would continue to play a significant role in Space Station design and development. By allocating Space Station design and definition to several NASA centers, and by utilizing the concept of "technical and contractual responsibility" whereby one center directs another's contractors, the work package system requires a strong, higher level of program management mandated to conduct systems integration and to resolve differences among centers. This will be achieved by the new Space Station office in the Washington, D.C. area.

ANTICIPATED COST AND BENEFIT AND IMPACT ON FACILITY AND PERSONNEL RESOURCES

NASA's analysis of the impact of the recommendations made by the Phillips Committee is that implementation of the recommendations will result in significant cost avoidance to the program. As a result of the Critical Evaluation Task Force activity at the Langley Research Center, a further improvement to the Phillips Committee recommendations is possible in terms of accountability.

The following illustrates the analysis that NASA has performed on the cost impacts of the various options on the previous baseline for module development and outfitting. Three options to the Phillips baseline single module developer and outfitter were analyzed:

1. A single module developer and dual module outfitter with the lab at Marshall (module development and integration at MSFC, lab and logistics outfitting at MSFC, hab outfitting at JSC).

2. A single module developer and dual module outfitter with the lab at Johnson (MSFC for development of modules and outfitting of logistics modules, JSC for outfitting hab and lab modules).

3. Dual module development and dual module outfitting responsibilities (MSFC develops and outfits lab and logistics, JSC develops and outfits hab).

Under the Phillips' recommendation, Marshall, with its prime contractor, would have the responsibility for developing and outfitting the laboratory, logistics and habitation modules. Johnson would provide technical direction to the Marshall contractor for the outfitting of the habitation module.

The recommended approach of having both modules developed by the same contractor provides considerable savings in design and manufacturing costs. Tooling, fixtures, and test equipment will be developed by one contractor, a substantial savings when compared to the cost of the unique development of two separate modules by two separate contractors. The costs associated with the hand-off will also be avoided.

The Phillips approach uses the expertise and institutional capability (test beds, trainers, etc.) existing at both Johnson and Marshall. The implementation of Option 1 would have no measurable impact on either civil service or projected support contractor staffing levels at the NASA field centers. With the technical direction at the Johnson Space Center for habitation module outfitting, there would be no requirements for personnel shifts between the Centers.

The first option, with Marshall and its contractor developing the modules and outfitting the laboratory and logistics modules and Johnson and its contractor outfitting the habitation module, is estimated to cost the Program $200-300 million more than the Phillips baseline because of the necessity for duplication of test and handling equipment. In addition, there would be numerous hardware hand-offs required, strongly diffusing contractor accountability and increasing schedule risk.

Option 1 makes appropriate use of the institutional capabilities and expertise resident at Marshall and Johnson. While the option requires no changes to the civil service staffing at any of the centers, it is estimated that up to 70 additional support contractor personnel would be required at Johnson to support the hand-offs of hardware.

The second option is a variation of Option 1. Marshall would develop the modules and outfit the logistics modules and Johnson would outfit both the laboratory and habitation modules under this option. This option exhibits all of the negative characteristics of Option 1--duplication of test and handling equipment, numerous hardware hand-offs, diffused contractor accountability and increased schedule risk. In addition, the benefits to the Program of MSFC's substantial laboratory outfitting expertise would not be applied. It is estimated that assigning laboratory outfitting responsibility to Johnson would necessitate adding up to 125 support contractor personnel to the Johnson workforce and would reduce the need for Marshall project personnel by up to 70 people. Civil service manpower would be unaffected.

The third option would have Marshall develop and outfit the laboratory and logistics modules and Johnson develop and outfit the habitation module. While this option would have appropriate use of the expertise and facilities at both Marshall and Johnson, as well as minimizing hardware hand-offs and providing excellent contractor accountability, the costs to the Program are significant. The substantial duplication of effort required for Option 3 was estimated to cost $900 million to $1 billion above the Phillips baseline approach and approximately 350 additional support contractors would be required at Johnson. Civil service manpower would be unaffected.

As a result of the Critical Evaluation Task Force (CETF) activities, another option became available to NASA. This option is similar to the Phillips baseline above with Marshall and its prime contractor having the responsibility for developing and outfitting the laboratory, logistics and habitation modules. However, as noted on page 10, Johnson would provide both technical and contractual direction to the Marshall contractor, via an exhibit in the Marshall contract, for the outfitting of the habitation module, thereby fully assuring Johnson's retention of control over Space Station manned systems.

As a result of the CETF activity, Marshall, likewise, would provide technical and contractual direction to the Johnson contractor for the propulsion engines. In addition, the resource nodes would be assigned to Johnson, with Marshall providing the node structure.

The CETF configuration is NASA's preferred approach. The cost impacts due to the configuration hardware improvements recommended by the CETF are still under review, but are believed to be small. The CETF configuration further improves contractor accountability over the Phillips Committee recommendation because there are even fewer hardware hand-offs required under this option. There is no duplication of work between Centers, and the expertise and institutional capability of Marshall in the area of propulsion technology is utilized, as well as the expertise and institutional capability of Johnson in the area of habitability. Civil service manpower requirements would remain unchanged at the centers, and no additional support contractor manpower is contemplated to be required.

Figure 2 on the next page illustrates the assessed costs and benefits as well as institutional implications of the work package options considered.

ANTICIPATED COST AND BENEFITS AND IMPACT ON FACILITY AND PERSONNEL RESOURCES

SOURCE	OPTION	COST	MANAGEMENT FACTORS	INSTITUTIONAL CAPABILITIES	CENTER MANPOWER
			PREVIOUS BASELINE		
Phillips Recommendation	Single module developer Single module outfitter	Cost base *	+ No duplication of work + Contractor accountability is maintained	+ JSC expertise used to provide technical direction to MSFC contractor + Test beds are used	+ Center Civil Service Manpower unchanged
Phillips Options	1. Single module developer Dual module outfitter Lab module at Marshall	+ 200 to 300 million dollars	- Multiple Hardware Hand-offs - Diffuse contractor accountability - Duplication of handling equipment, etc...	+ Used appropriately	+ Center Civil Service Manpower unchanged, (i)
	2. Single module developer Dual module outfitter Lab module at Johnson	+ 200 to 300 million dollars	- Multiple Hardware Hand-offs - Diffuse contractor accountability - Duplication of handling equipment, etc...	- Laboratory expertise at MSFC is not applied	+ Center Civil Service Manpower unchanged, (ii)
	3. Dual module developer Dual module outfitter	+ 900 million to 1 billion dollars	+ Minimize Hardware hand-offs + Good accountability - Duplication of work	+ Used appropriately	+ Center Civil Service Manpower unchanged, (iii)
			CETF CONFIGURATION		
NASA Preferred	Single module developer Single module outfitter Resource Nodes at Johnson	Cost base **	+ Accountability is improved over option 1. + Hardware hand-offs are fewer than option 1 + No duplication of work	+ Improved over option 1 by applying JSC technical and contractual direction for hab module outfitting, and MSFC technical and contractual director for propulsion + Use MSFC propulsion test bed	+ Center Civil Service Manpower unchanged

* Cost numbers are variations from this base
** Cost impact due to configuration improvements are believed to be small and are under review

(i) Up to 70 additional support contractors at JSC
(ii) Up to 125 additional support contractors at JSC and reduction of up to 70 project personnel at MSFC
(iii) Up to 350 additional support contractors at JSC

August 20, 1986

CHARTER
FOR THE
SPACE STATION CONFIGURATION
CRITICAL EVALUATION TASK FORCE

STATUS --

In the time since January 1984, when President Reagan directed NASA to develop a permanently manned Space Station within a decade, NASA has made substantial progress in defining Space Station architecture and systems. The principal result of two and a half years of analysis, by both NASA and industry, was the establishment, in March 1986, of a baseline configuration for the Space Station. Canada, Europe and Japan - potential partners with the United States in the Space Station endeavor - contributed their analyses to this configuration as well. The baseline configuration is intended to form the basis for preliminary design, and to serve as the focus for the Phase C/D hardware development competition.

CONCERNS --

The baseline configuration meets many of NASA's preliminary technical objectives for the Space Station, including accommodation of user requirements. It has been assessed by groups inside and outside of NASA. Specific concerns, however, have been raised that require critical evaluation. They are:

- Compatibility between the current assembly scenario for the Space Station baseline configuration and the transportation system this nation will have in the early to mid 1990's.
- Extensive Shuttle-based and time-constrained extravehicular activity (EVA) required for assembly and maintenance of the Space Station baseline configuration.
- Adequacy of safety margin provided by the "safe haven" concept currently incorporated in the Space Station baseline configuration.
- Adequacy of the proposed assembly scenario for the Space Station baseline configuration to support early scientific utilization.

CRITICAL EVALUATION TASK FORCE --

To address the concerns raised with the current baseline configuration, and in response to directives from the NASA Administrator, NASA has established a Space Station Configuration Critical Evaluation Task Force. The Task Force reports to the Associate Administrator for the Office of Space Station at NASA Headquarters, Washington, DC. The objective of the Task Force is to critically evaluate the current Space Station baseline configuration and to identify systems designs and configuration options and assembly scenarios that address the issues of transportation limitations, EVA constraints, resource allocations, safety and utilization phasing.

A set of task groups has been established to develop systems designs and configuration options. These groups and their objectives are as follows:

Transportation Limitations Task Group

- Assess transportation capability for Space Station assembly, logistics, operations and growth
- Develop and evaluate transportation augmentation and contingency options, including use of National Space Transportation System and expendable launch vehicles.

EVA and Habitability Constraint Task Group

- Evaluate EVA requirements for assembly, maintenance and servicing of the Space Station systems and payloads.
- Develop and evaluate alternative assembly sequences and concepts to reduce EVA needed for Space Station construction and systems maintenance and servicing.
- Evaluate crew stay time and rotation requirements.
- Develop and evaluate options to enhance habitability and operations within pressurized modules.

User Accommodation Assessment Group

- Define user requirements that influence Space Station configuration.
- Define and evaluate representative payloads and mission sets that could be accommodated by the Space Station during assembly and early operations phases.
- Evaluate ability of configuration/assembly options to accommodate current set of user requirements

Resource Assessement Task Group

- Review allocations for critical resources such as power, weight and volume.
- Develop and evaluate alternate methods of supplementing critical resources.
- Evaluate configuration and assembly options with respect to ability to minimize the use of critical resources.

Safety Assessment Task Group

- Evaluate configuration options developed by other task groups to assure compatibility with safety requirements for assured resupply, safe haven and/or crew rescue and launch-on-demand.

Cost Assessment Task Group

- Evaluate difference in development and projected operations costs between baseline and configuration/assembly options developed by other task groups.
- Estimate rough order of magnitude costs for any new elements

Configuration/Systems Task Group

- Define and document Space Station baseline configuration and evaluate with respect to critical parameters such as assembly sequence, EVA for assembly and maintenance, transportation, utilization, resources, safety and cost.
- Develop assessment criteria for judging alternative configurations.
- Using data provided by other task groups, develop configuration options, and then critically analyze and evaluate those options for their ability to correct deficiences in the baseline configuration with respect to assembly sequence, EVA for assembly and maintenance, transportation, utilization, resources, safety and cost.

The Space Station Configuration Critical Evaluation Task Force is located at the NASA Langley Research Center in Hampton, VA. The separate task groups will interact as required with each other, and with the NASA Executive Technical Committee. This committee provides guidance and oversight to the Task Force. The Task Force will interact with and utilize NASA field centers and the Phase B contractors in performing the study. Representatives of Canada, Europe and Japan will also participate in the activity.

PRODUCTS OF THE EVALUATION EFFORT --

The current schedule calls for the Task Force to complete its technical evaluation of the Space Station configuration by no later than October. The evaluation effort will result in the development of the following:

- Systems designs and configuration options and related assembly scenarios that serve as possible solutions to concerns about EVA, transportation, early productive utilization and safety.

- A cost difference for each of the options defined against the baseline configuration

MEMBERSHIP -- (as of 9/2/86)

Critical Evaluation Task Force
W. Ray Hook, Chairman, LaRC

I. **Transportation Considerations**
Lead: Charles Texeira, JSC
Gerald Kenney, STS JSC
Gus Guzinsky, MSFC
Hal Loden, JSC Level B
Frank Swalley, MSFC
Harold Miller, HQ
O'Keefe Sullivan, MSFC

II. **EVA Considerations**
Lead: Ray Roberts, KSC
John Rivers, JSC Level B
Dave Walker, JSC
Ron Gerlach, JSC
Norman Prince, JSC
Ronald Miller, GSFC
Manny Rodriguez, JPL
Bruce Webbon, ARC
Bob Goss, MSFC
Dennis Webb, JSC
Kent Volkmer, JPL

III. **Resource Assessment**
Lead: Bill Tumulty, HQ
Sam Bergeson-Willis, GSFC
Jim Akkerman, JSC Level B
Jim Cioni, JSC
Gerry Barna, LeRC
Tom Hollingsworth, MSFC
Chris Jones, JPL

IV. **Configuration/System**
Lead: Dick Snyder, LaRC
Doug Cooke, JSC Level B
Buddy DeRyder, LaRC
Bill Creasy, JSC
George McKay, MSFC
Maynard Dalton, JSC Level B
Joe Skladany, GSFC
Joe Young, GSFC
P. Sabelhaus, GSFC
Dave Homan, JSC
Frank Bryan, KSC
Joe Talbot, LaRC
Steve Brody, JSC (international coordinator)

V. **User Considerations**
Lead: Richard Russell, LaRC
Alan Holt, JSC Level B
Tim White, JSC Level B
Arthur Boese, MSFC
Dave Suddeth, GSFC
Michael Devirian, HQ
Bill Ramage, MSFC
Ex-Officio Members:
Ken Demel, JSC
John Mitchell, JSC
J. Mankins, JPL

VI. **Cost Estimate**
Lead: Bill Rutledge, MSFC
Richard Fox, JSC Level B
Hum Mandell, JSC
Bill Hicks, MSFC
Tom LaCroix, LeRC
Mark Fontaine, GSFC

VII. **Safety Assessment**
Lead: Dick Storm, HQ
Hank Williams, JSC Level B
D. Andrews, MSFC
Bryant Cramer, HQ

Carroll Dawson, JSC
John Dunning, LeRC
Jack Hall, LaRC
Ben Wada, JPL
Dwayne Weary, JSC Level B
Denny Kross, MSFC
Floyd Ford, GSFC
Bernard Garrett, LaRC
Francesco DiMauro, ESA
Tak Kato, NASDA (Japan)
Bryan Erb, MRC (Canada)

August 20, 1986

CHARTER
FOR THE
NASA EXECUTIVE TECHNICAL COMMITTEE

STATUS --

A NASA Executive Technical Committee (NETC) has been formed as part of the Space Station configuration assessment process to approve the engineering analysis, technical constraints and assumptions, as well as to provide the technical oversight and guidance to the Critical Evaluation Task Force (CETF).

The NETC is chaired by the Associate Administrator for the Office of Space Station. It includes senior representatives from the appropriate support organizations at NASA Headquarters, the astronaut office, the user community, engineering organizations at various NASA centers, and the program and project managers currently directing the Phase B (definition and preliminary design) activities.

CHARTER --

The specific charter of this committee is as follows:

- Review and approve the specific Task Force study plan and schedule to assure the objectives of the Task Force are appropriate and will be met.
- Review and approve the updated assumptions and technical constraints for use by the Task Force in the accomplishment of the study.
- Review the status and preliminary data of the Task Force on a frequent basis, and provide top-level oversight and guidance to the study.
- As technical options are devised, analyze overall impact on the users, international partners and the NASA centers, their contractors and support organizations.
- Examine work package assignments and recommend changes as required based on the impact of any forthcoming design modifications so as to minimize development costs and achieve simple, controllable interfaces.
- Synthesize data for presentation of options and recommendations to the NASA Administrator.

MEMBERSHIP --
(as of 9/2/86)

The membership of the Committee is as follows:

Chairman: Andrew J. Stofan
Associate Administrator, Office of Space Station

Terence T. Finn, Office of Space Station
Executive Secretary

Members:

Peter Banks, chairman, Task Force on Scientific Uses of the Space Station
Aaron Cohen, director of research and engineering, JSC
Gordon Fullerton, astronaut office, JSC
Paul Holloway, deputy director, LaRC
Jim Kingsbury, director, science and engineering, MSFC
Les Meredith, associate director, GSFC
Tom Moser, Office of Space Flight, HQ
Robert J. Parks, deputy director, JPL
Ted Sasseen, chief engineer, KSC
Steven V. Szabo, chief, space transportation engineering division, LeRC

John Aaron, acting program manager, Level B
Luther Powell, project manager, WP-1
Clarke Covington, project manager, WP-2
Ronald Browning, project manager, WP-3
Ron Thomas, project manager, WP-4

MEMORANDUM OF UNDERSTANDING
BETWEEN
NASA/JOHNSON SPACE CENTER
AND
NASA/MARSHALL SPACE FLIGHT CENTER

The LYNDON B. JOHNSON SPACE CENTER of the NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA), hereinafter referred to as JCS, and the GEORGE C. MARSHALL SPACE FLIGHT CENTER, also of NASA, hereinafter referred to as MSFC, desire to enter into a MEMORANDUM OF UNDERSTANDING, hereinafter referred to as AGREEMENT. The objective of this Agreement is to insure the efficient and effective application of the Man-Systems discipline to the Space Station Program during the programmatic phases leading up to operations.

The parties mutually agree to the following:

ARTICLE I--RESPONSIBILITIES OF MSFC

A. MSFC, Space Station Work Package 1, Level C Project Office, has the programmatic responsibility for outfitting (installation, integration and end-to-end verification) of the habitable elements of the Space Station.

B. MSFC, Level C Space Station Project Office, in recognition of the responsibility of JSC, as defined by the NASA Administrator, Level A, and Level A' technical direction, to accomplish Man-Systems Definition and Development, will provide for the negotiation of a unique exhibit within their WP-1 contract for the definition, design, development, test and delivery of the Space Station Man-Systems subsystems, components and hardware (as defined on Enclosure 1 to this Agreement) whereby these responsibilities may be discharged. This exhibit will be technically directed and managed by JSC, and will be applicable to the Man-Systems subsystems, components and hardware identified as Prime in the Man-Systems Architectural Control Document. MSFC will include requirements within the Space Station WP-1 overall contract for separate performance reporting on the effort covered by the JSC exhibit. This will include reports on contract performance in costs, schedule and technical progress. MSFC will also assure that the JSC evaluation of this progress is considered in the overall evaluation of the WP-1 contractor performance.

C. MSFC will establish a POP budget line item covering the unique Man-Systems exhibit within the Space Station WP-1 contract. The MSFC Level C, CCB shall be the authority for addressing proposed changes which fall outside the initially negotiated boundaries of technical and schedule scope for the unique exhibit, or which exceed the total POP line item budget approval. All such proposals will be submitted to the MSFC, Level C, CCB for approval prior to implementation.

ARTICLE II--RESPONSIBILITIES OF JSC

A. JSC will provide technical and subsystem management and direction for the definition, design, development, test and delivery of the Man-Systems requirements and hardware by managing and technically administering the unique Man-Systems exhibit of the WP-1 contract. JSC will maintain the routine technical interactions with the contractor. JSC will evaluate contractor cost, schedule, and technical progress in a timely manner to support the MSFC overall evaluation of the WP-1 contractor. JSC will be responsible for supporting contractor fee evaluations or agreements and participating in contract management functions as appropriate.

B. JSC will administer and manage the POP line item budget created by MSFC for the Man-Systems Exhibit. JSC will have change authority for the Man-Systems exhibit of the WP-1 contract, within the exhibit scope. JSC will also administer and manage the POP budget line created by the Space Station Program Office to fund the activities associated with the items relevant to paragraphs D&E below.

C. JSC will have the responsibility for definition, development, and management of the Man-Systems Architectural Control Document.

D. In addition to, and separate from the WP-1 Man-Systems Exhibit, JSC will provide all rack-mounted crew health care equipment to WP-1 for installation, integration and verification. Definition, design, development, test, delivery and manifesting of the Man-Systems equipment identified as Non-Prime in the Man-Systems Architectural Control Document will be managed by JSC outside the scope of the unique Man-Systems Exhibit. For launch manifesting of all loose equipment, JSC will manage the Crew Compartment Configuration Control Drawing in a manner consistent with previous programs.

E. JSC will provide definition, design, development, maintenance and operation of the Man-Systems Test Bed, mockups, trainer and systems support facilities for the Space Station Program.

F. JSC will manage and chair all technical panel activities required to execute Man-Systems responsibilities for the Space Station Program.

ARTICLE III--EFFECTIVE DATE, DURATION, AND TERMINATION

This Agreement shall become effective upon the last signature hereto, and will remain in effect through Space Station IOC and, therefore, to provide for sustaining engineering in support of operations.

ARTICLE IV--AUTHORITY

This Agreement is entered into by the Director of the Lyndon B. Johnson Space Center and the Director of the George C. Marshall Space Flight Center in accordance with the authority set forth in the National Aeronautics and Space Act of 1958, as amended.

FOR JSC

Jesse W. Moore
Director

FOR MSFC

T. J. Lee
Acting Director

CONCURRENCE:

Andrew J. Stofan
Associate Administrator for
Space Station

MANNED SYSTEMS SUBSYSTEMS, COMPONENTS AND HARDWARE PROVIDERS

SUBSYSTEM	COMPONENTS	PROVIDER	
		Non-Prime JSC	Prime
CREW QUARTERS			
	Sleep Station		x
	'Office' Provisions		x
	Personal Stowage Provisions		x
RESTRAINTS AND MOBILITY AIDS			
	Fixed Restraints		x
	Portable Restraints, Hard		x
	Mobility Aids		x
CREW HEALTH CARE			
	Health Maintenance Facility	x	
	Exercise System	x	
	Environmental Health	x	
	Medical Data Mgmt	x	
	Medical Hyperbaric	x	
OPERATIONAL AND PERSONAL EQUIPMENT			
	Clothing	x	
	Cameras	x	
	Pens, Pencils	x	
	Soft Restraints	x	
	Equipment Restraints, Soft	x	
PORTABLE EMERGENCY PROVISIONS			
	Food	x	
	Waste Collection, Bags	x	
	Hygiene	x	
	Maintenance	x	
	Emergency Tools	x	
	Portable Breathing	x	
	Trash Mgmt	x	
	Medical Supplies	x	

SUBSYSTEM	COMPONENTS	PROVIDER	
		Non-Prime JSC	Prime
PORTABLE EMERGENCY PROVISIONS (CONT.)			
	Sleep Provisions	x	
	Lighting	x	
	Clothing	x	
HAB AND LAB WORKSTATIONS	Command & Control		x
	Prox Ops		x
	Window		x
	Portable		x
	User		x
	Maintenance		x
	Tools & Equipment	x	
	Supplies	x	
	Diagnostic Equip.	x	
	Controls & Displays		x
	Restraints		x
	Work Surface		x
	Diagnostic Applications S/W		x
GALLY/FOOD MANAGEMENT			
	Food	x	
	Ambient Stowage		x
	Handwasher		x
	Trash Compactor		x
	Oven		x
	Water Chiller/ Dispenser		x
	Dishwasher		x
	Food Prep/Service Equipment	x	
	Cleaning Supplies	x	
PERSONAL HYGIENE			
	Shower		x
	Hand/Face/Eyewash		x
	Human Waste Collection		x
	Hygiene Aids/ Provisions	x	

SUBSYSTEM	COMPONENTS	PROVIDER	
		Non-Prime JSC	Prime
ILLUMINATION			
	Local Area, Fixed		x
	Portable	x	
WARDROOM			
	Multipurpose Table		x
	Entertainment Equipment	x	
	Viewing (Window Provisions and Cameras)	x	
INTERFACING PARTITIONS & STRUCTURES			x
STOWAGE			
	Hardware		x
	Containers		x
	Restraints, Fillers	x	
	Soft Goods	x	
HOUSEKEEPING/TRASH MANAGEMENT			
	Inventory Mgmt & Control		x
	Trash Mgmt, Soft Goods	x	
	General Cleaning Provisions	x	
	Laundry		x
	Installed Hdwe		x
	Portable Hdwe	x	